ERBSLÖH Juice and Fruit Wine Seminar 2024

21. & 22. March 2024

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Enzyme applications beyond EU-Directive for fruit juices...

(currently in use is Directive 2012/12/EU of 19 April 2012)

D-Rotenburg an der Fulda, at 21.3.2024

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Agenda

1. Why ezymes and which enzyme activities can be even more helpful ?
   - What enzymes in general can offer ?
   - Simplified Plant cell wall, substances and enzymes to degrade or modify them....

2.1 Several “Bioinnivations” applications examples with enzymes in mainly Food processing

2.2 Which enzyme activities can be useful beyond current EU Directive for fruit juice ?

3. Conclusion and Summary

3.1 A solution to update current EU-Directive for fruit juice can be Ammendment 198 from 25.9.2023 ?

3.2 The word “Enzyme preparations” can be used and not only “single enzyme activities”

4. Literature

e.g. Current legal stauts: **EU- Directive 2012/12/EU** for fruit juices (incl. vegetables), upcoming FIAP, etc...
and several paper work with laccase trials results...

1. **Why enzymes -** What enzymes can offer ?

1

Mainly Enzymes can do the job

All fruits and vegetables contain various high molecular substances (proteins, carbohydrates), which are detrimental for extraction and clarification, etc.

- Starch
- Pectins
- Hemicelluloses
- Celluloses
- Proteins
- phenolics/tannins

Degradation of these above substances is only or mainly possible by using enzymes!

Except: phenolics/tannins can be precipitated (with bentonite, gelatine, plant proteins etc.) but not yet degraded "legally" with enzymes...

2

Covering fruit and vegetable juices and wine applications

Enzymes are the only processing aid which can be
used several times in the juice making process:

- "Backbone of fruit and vegetable juices and wine making"
- Several applications: mashing, clarification, filtration and enhance healthy substances
- Useful for all vegetable and fruit juices and wines

3

Deliver benefits in…

Whatever the juice and wine making step, enzymes deliver economical and qualitative benefits for juice and wine makers

- Yield increase and capacity increase
- Clarification and stabilization enhancement
- Filtration improvement
- Color extraction, stabilisations, also Healthy substances enhancement and other nutritionally important components, such as beta carotene, lycopenes, phenolic compounds, oleuropein, etc.

Three questions to **better** understand **“Enzymes”** and applications

1

Enzymes are involved in many different applications with fruits and vegetables?

Because it is all about the same…

Breaking down and modifying mainly:
Pectin, Hemi Cellulose & Cellulose
To extract juice and healthy substances, etc.

It’s true for Apples, Berries, Wine, Citrus fruits, vegetables, Tropicals, olive, and more...

And also for Pepper, Tea, Coffee, cacao, sugar beet, and more …

2

Which enzymes activities can modifying plant cell walls?

In general we have currently 3 enzyme composition variants:

[Pectinase]
[Pectinase + Hemi Cellulase]
[Pectinase + Hemi Cellulase + “Cellulase”]

The differentiated enzyme compositions can be adapted to the different raw materials needs

3

What is currently allowed in EU- Directive 2012/12/EU ?

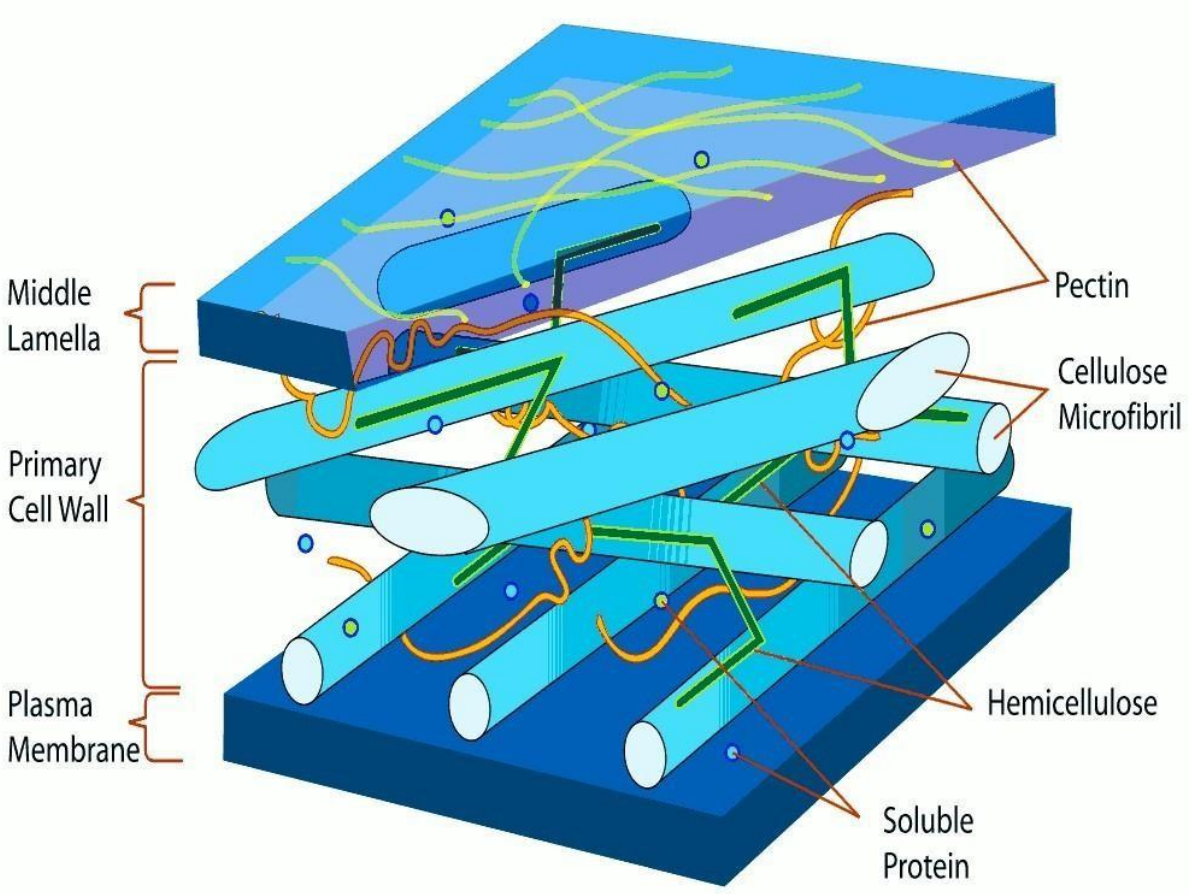
Pectinase, Amylase, Protease for fruits

in addition, **cellulase** for vegetables

Which other enzymes, can be helpful ?

-Cellulases, Glucanases, Cellobiases, etc.
-Laccases, Tannases, etc.
-Invertase, Fructosyltransferases (inulinases), GOX, Galactosidases, etc
-Glycosidases, Dextranases. etc-
-Mananases, phospholipases, etc.
-Others ?

The principles of extraction: Degradation of the matrix…



The cell walls of apple/pears and grapes are built up by various matrixes

1. *Cellulose +*
2. *Pectins; primary and secondary (poly/oligo-saccharides) +*
3. *Hemicelluloses (xyloglucane, arabino-galactane, etc.) +*
4. *“Soluble proteins”*

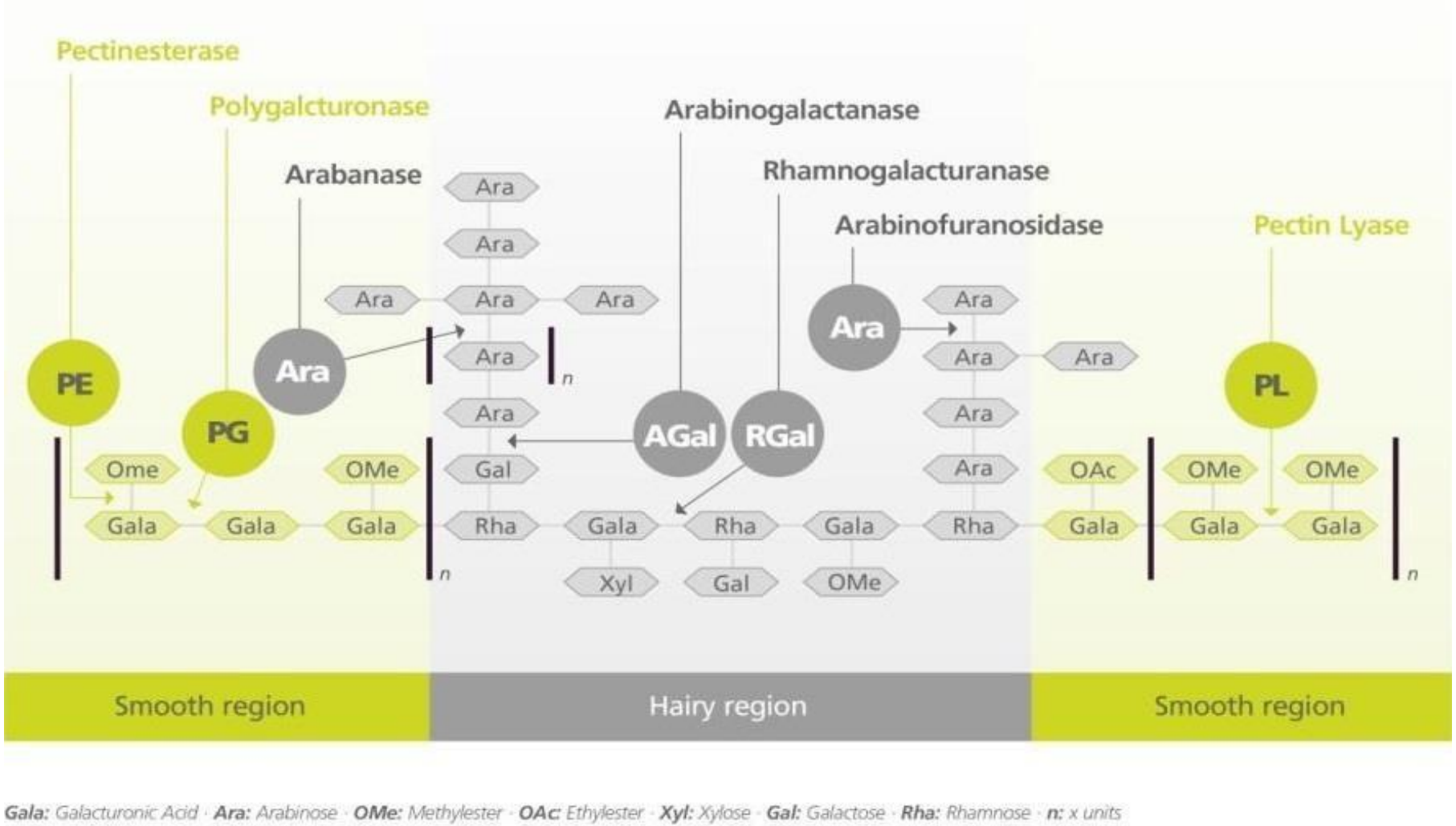
According to exact application, their complex structure can be degraded in a different way

- **In-deep or specific degradation** is necessary for maceration

- **Fast degradation** is necessary for clarification and Flotation

- Other degradations or modifycations...

Simplified example for Fruit pectin model



Gala: *Galacturonic Acid* · **Ara:** *Arabinose* · **OMe:** *Methylester* · **OAc:** *Ethylester* · **Xyl:** *Xylose* · **Gal:** *Galactose* · **Rha:** *Rhamnose* · **n:** *x units*

Plant cell wall, carbohydrates, and enzymes types

Cellulose	beta-1,4-glucan	all left substances can be degraded with: multicomponent enzymes: pectinase, hemicellulase and cellulase, such as **glucanases, etc.**
Hemicelluloses	beta-1,3-1,4-glucans, xyloglucans, xylans (arabinoxylans), mannans (galactomannans), galactans (arabinogalactans), arabinans	main left substances can be degraded with: Clarification enzyme: **pectinase and arabianases**, etc.
Pectic substances	homogalacturonan (pectin), rhamnogalacturonans, xylogalacturonan	homogalacturan pectin can be modified and degraded with: **specific modern pectinase (PG/PE or PL) for macerating to make clear juices or to make cloud stable juices...**

2.1. “Bioinnovations” applications in Food, etc, see examples

a) Optimizing filtration

b) Extract more, extract better

c) Smooth liquefaction/viscosity management

d) Saccharification made easy

e) others, e.g. Laccase (PPO)

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“Bioinnovations” across applications

Improve process efficiency and the quality of the end product while reducing energy consumption with enzymatic process enhancements.

Red wine

Oil

Beer

Alcohol

Jeans

Syrup

Maltose syrup

Juice

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Get the best beer filtration

In the old days…

… beer was filtered without enzymes.

This meant that the brewer did not get the maximum benefit from the raw materials, even if they were of outstanding quality.

With bioinnovation…

... brewers can produce quality beers from available raw materials supplied with variations in quality.

Enzymatic filtration raises the benchmark for mash separation and beer filtration, providing process predictability and consistency for improved quality and cost-efficiency.

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Better maltose syrup for better candy

In the old days…

… filtration rates were short, and maltodextrin filtrates had less clarity during the production of high maltose syrups from wheat starch.
In addition, dextrose generation was also a problem.

With bioinnovation…

… the results are increased filtration rates, improved clarity of maltodextrin filtrates, and low generation of dextrose.

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Enzymatic essential oil recovery

In the old days…

… essential citrus oils, etc. were recovered through centrifugation during the juice extraction, etc. process, using water, etc…

This process involved large amounts of water, wear and tear on the centrifuge, and multiple cleaning cycles.

With bioinnovation…

… specific enzyme preparations increase the yield of essential oils.

Enzymatic oil recovery improves the performance of the centrifuge, cuts down the number of cleaning cycles, and reduces water consumption.

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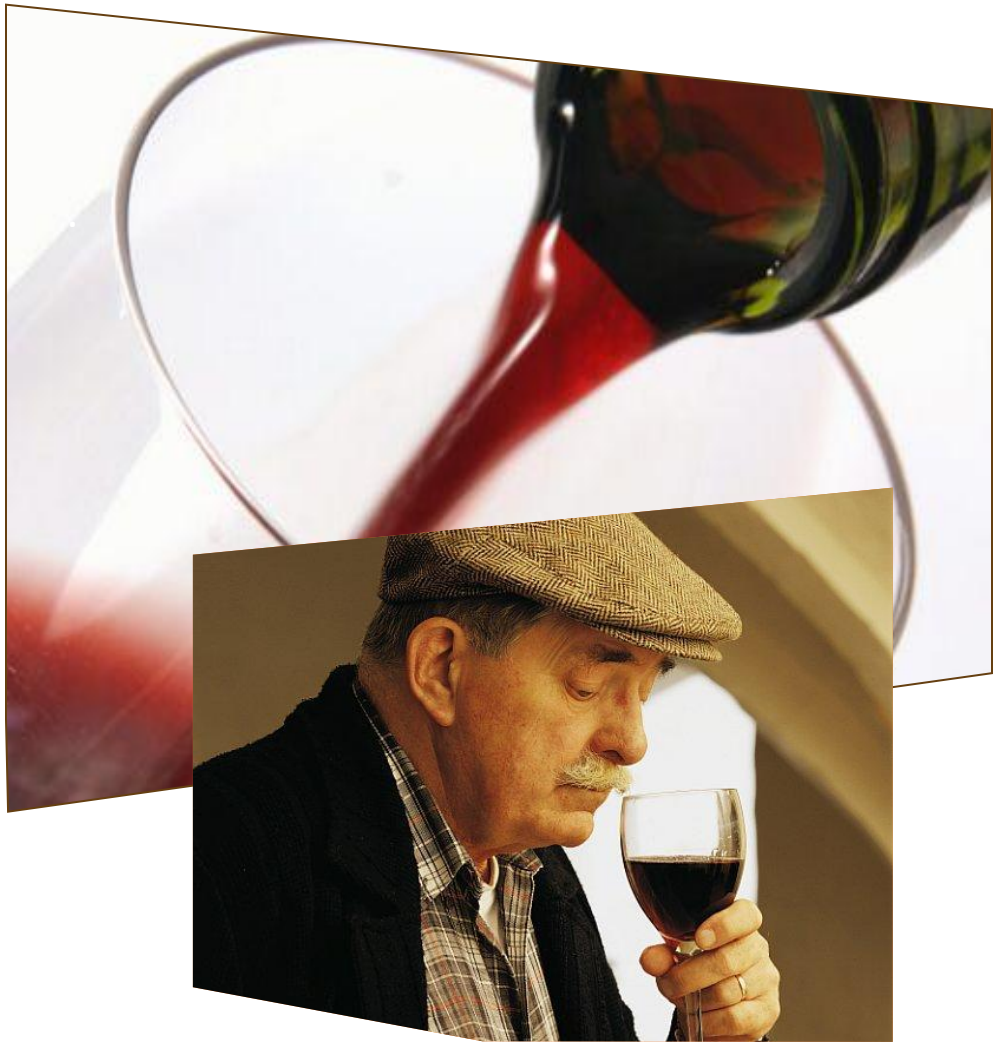
Enzymatic wine maceration, and more…



In the old days…

… wine maceration, which brings out the aroma and color of a wine, relied on heat and alcohol plus sulfur dioxide in the case of cold maceration.

This process was slow, did not extract all the aroma and flavor, and was not a reliable process, so the end product did not have consistent aroma and color.

With bioinnovation…

… the maceration process is optimized and the maceration time is reduced by 20%.

In addition, enzymes optimize extraction of valuable tannins, anthocyanins, and aroma compounds. They also extract fruity aroma and enhance mouthfeel.

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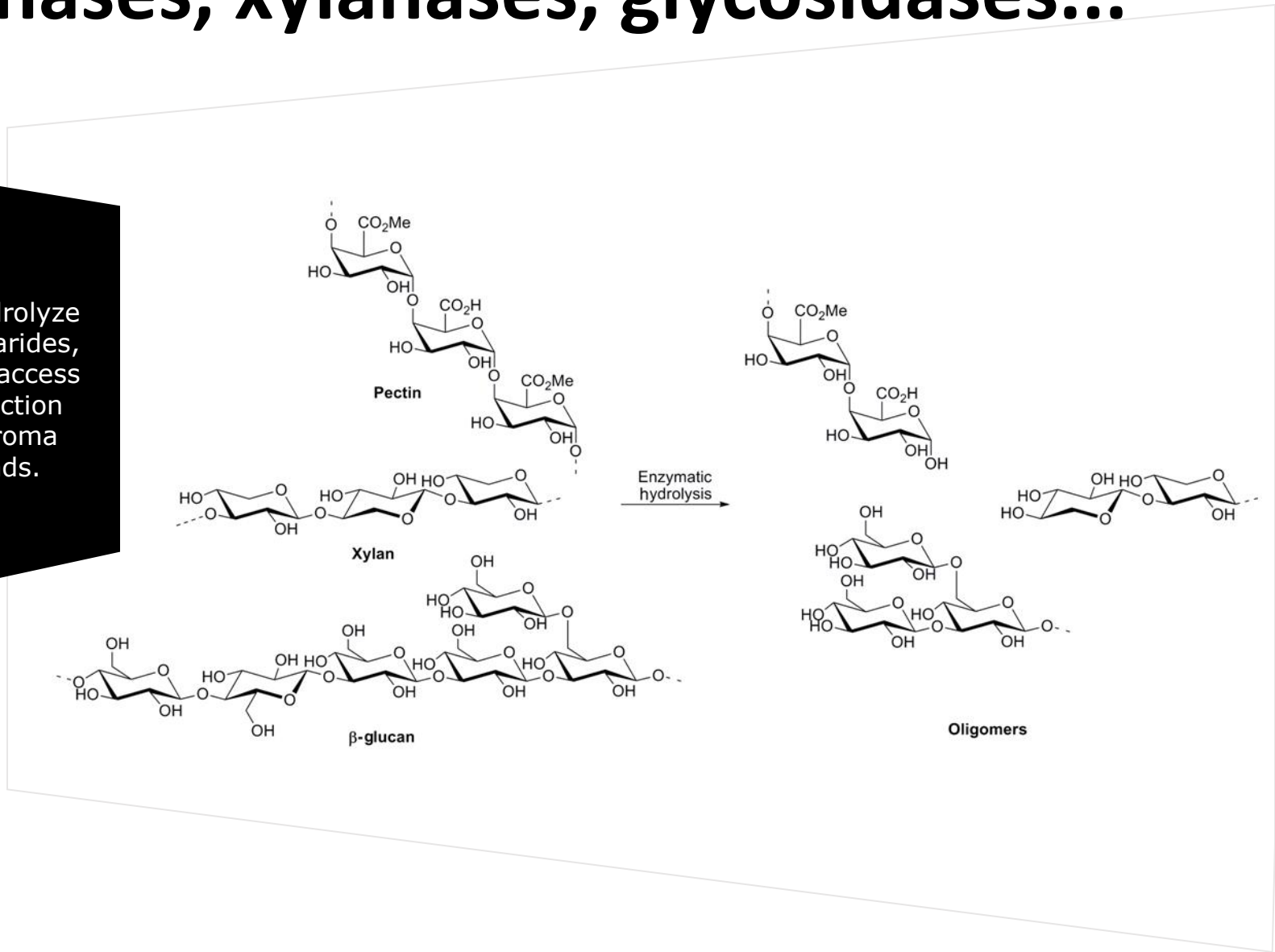
The chemistry behind all this applications: are cellulases, such as **glucanases, xylanases, glycosidases…**

Carbohydrases hydrolyze cell wall polysaccharides, resulting in easier access to and better extraction of the important aroma and color compounds.



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Inverting sugar to make it better **or different…**

In the old days…

… there was a high risk of sugar browning when it was inverted.

The viscosity of the sugar mass and the crystallization of the saccharose made it difficult to use the inverted sugar.

With bioinnovation…

… sugar can be inverted to preserve texture, enhance sweetness, and improve flavor and color.

Enzymes are an easy way to invert sugar without browning while reducing viscosity and preventing crystallization.

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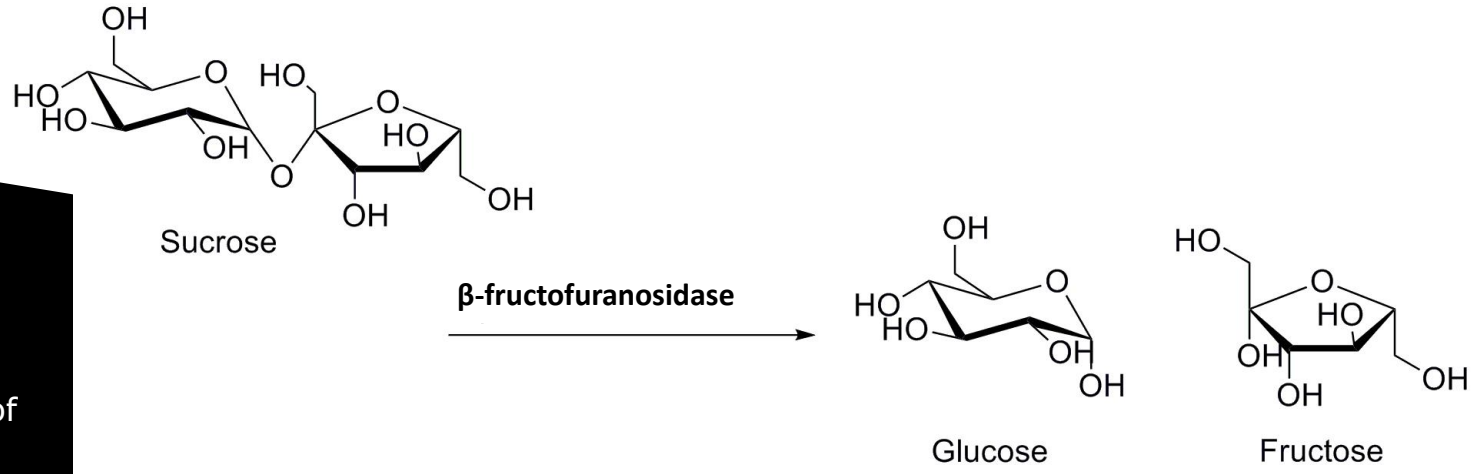
The chemistry behind sugar inversion, and sugar reductions, sugar managements, etc.

β-fructofuranosidase hydrolyzes sucrose into glucose and fructose to prevent crystallization of sucrose, release the sweet taste, and improve the color.



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Not Food appliction, but example for laccase (PPO) reactions: Stonewashed jeans without chemicals and stones…

Photo illustrating the different finishes and benefits of using an enzymatic process.

In the old days…

… denim was bleached with strong oxidizing agents like permanganate, hypochlorite, and hydrogen peroxide to get a stonewashed effect.

These chemicals are bad for the environment, make it difficult to control the bleaching effect, and can damage the jeans.

With bioinnovation…

… the stonewashed/bleached effect can be achieved without damaging the fabric or the environment.

Enzymes replace chemicals and save water, energy, and processing costs.

The end product has a better finish when processed with enzymes.

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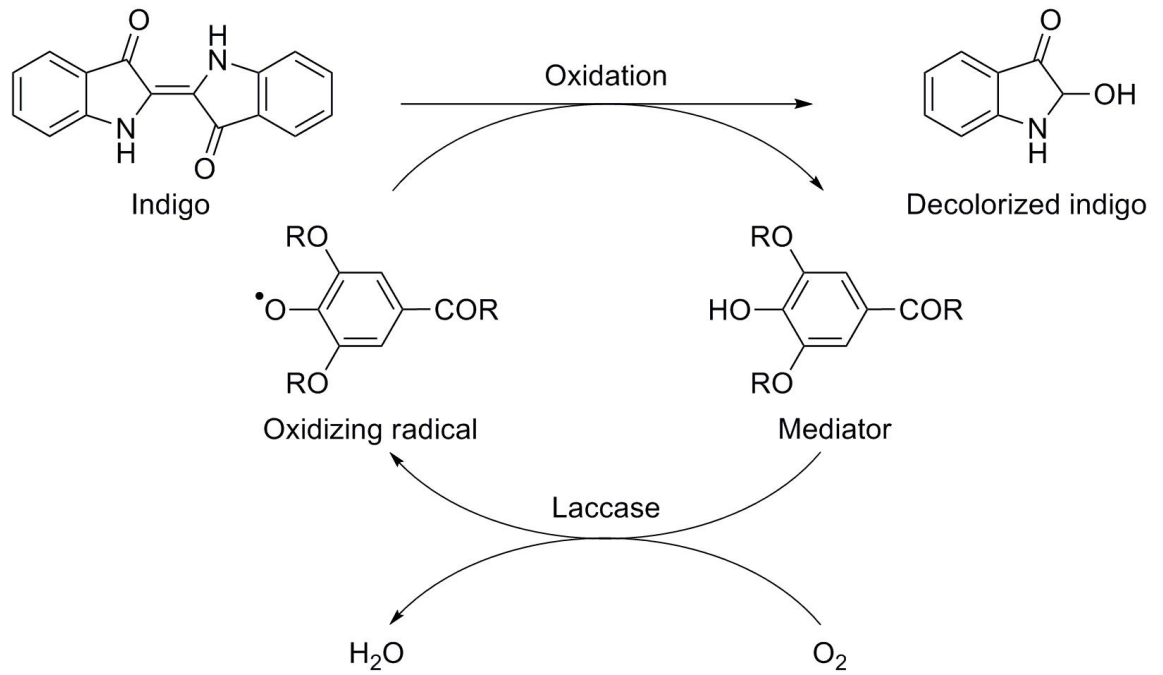
The chemistry behind Stonewashing jeans with enzymes, such as laccases (PPO)…

Laccase uses oxygen to create radicals that oxidize the blue indigo dye into a colorless compound.



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2.2 Which enzyme activities can be helpful beyond current EU Directive ?

- Cellulases, e.g. glucanases, cellobiases, etc. for better filtration and extractions, etc.
- Laccase (PPO) for stabilisation and replacing chemicals in juice and wine processings. Also laccase can clean, e.g. corks, filtration membranes, etc...
- Tannase also for stabilisation and replacing chemicals
- Invertase (frutofuranosidase), fructosyltransferase, Inulinase, GOX (glucose oxidases), Lactase (Galactasodiase), etc. for e.g. “sugar reductions” and “sugar managements”
- Mananases for processing of tropical fruits (e.g. pineapples) for flux increase, etc.
- Phospholipases to manage e.g. waxes, etc.
- Glycosidases for flavour enhancements and also debittering of citrus fruits
- Others, e.g. Dextranase for better processing of sugar beets, red beets, etc. to increase filtration rates, etc.

3. Conclusion and summary

3.1 Amendment 198 from 25.9.2023, can be a solution to update current EU-Directive ?

Proposal for a directive Annex I – paragraph 1 – point 1 a (new) Directive 2001/112/EC Annex 2 – paragraph 1 – point 7 a (new)
Text proposed by the Commission **and see this below** Amendment (1a) In Annex II is added a new point with follows:

> "Enzyme preparations: pectinases (for breakdown of pectin), proteinases (for breakdown of proteins), and amylases (for breakdown of starch), cellulases (limited use to facilitate disruption of cell walls), meeting the requirements of Regulation (EC) No 1332/2008 of the European Parliament and of the Council of 16 December 2008 on food enzymes;"

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Justification

The use of enzyme preparations of cellulase is already laid down in the Codex Standard for fruit juices. Cellulases are used to improve and optimize the extraction and clarification, as well as cloud stability and texture, and to decrease viscosity of nectars and purees from tropical fruits.

3.2 The word Enzyme preparations can be used and not listing of “single enzyme activities”, such as pectinase, amlyase and protease (and cellulase for vegetables)

Tailor made “Enzyme preparations” with so called main and side activities, are widely used in fruit and vegetable processing for many good reasons. They enable to increase yield, shorten processing time and improve product quality.

Enzymes can refine, upgrade and enhance a wide range of industrial processes for a variety of finished products and contribute especially to reducing waste and production costs, beeing more sustainable and eco-frinedly

For already more than 80 years, enzymes are well known to develop products with and for customers and their applications in Food and Beverage applications, such as also Fruit- and Vegetable juice processing.

With the amendment 198, a first good step can be taken, to update use of enzmes in the current EU-Directive for fruit juices...

4. Literature

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R&D meets Sales

Alexandra Steffens, Project Engineer R&D

Lars Eisel, Sales Engineer Fruits & Cereals

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Sales Philosophy

Sales force - not an end in itself!

- The aim is to address and advise each customer individually
- Important core elements of sales:
  - ✓ Employees are experts in their field
  - ✓ Extensive wealth of experience
  - ✓ Broad product portfolio
  - ✓ The Erbslöh service laboratory

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Erbslöh Service Lab

- Quality
- Service Lab
- New product development

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From enquiry to solution

According to the book vs. Taylor-made

- Definition of specific tasks
- Analysing the initial situation
- Which interfering factors are present?
- Solution can result from:
  - Process control
  - Treatment with special product
  - New product development

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New product development

Concept

- Customer request
- Progress is our future

Development product

- Lab analysis
- Application-oriented

New product

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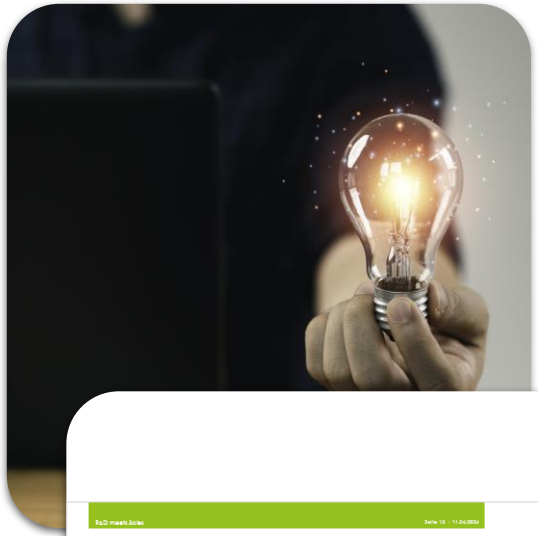
Example from practice - Enerzym Range

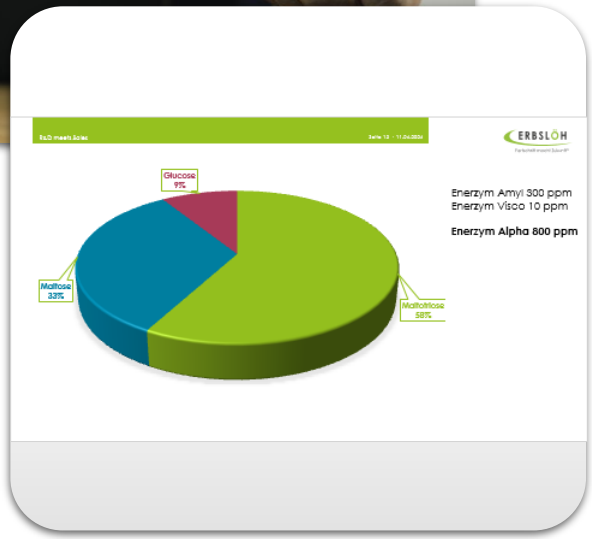
Concept

- Sugar profiles in plant drink

Development product

- Testing the Enerzym Range





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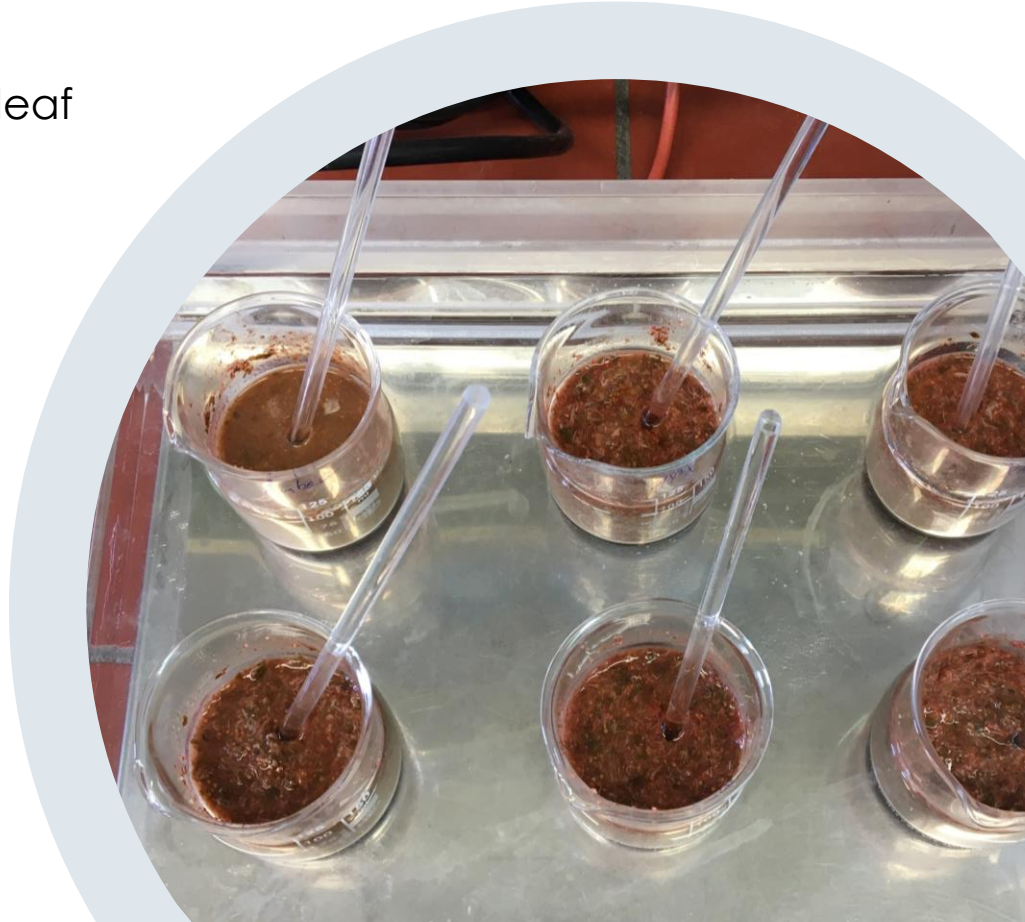
Example from practice

Strawberry pomace

Task: Jam manufacturer wants to utilise the pomace produced

Idea: Enzymatic processing to enable separation of nutlets, pulp and leaf residues

- Not an everyday enquiry
- Start with screening of different enzyme activities



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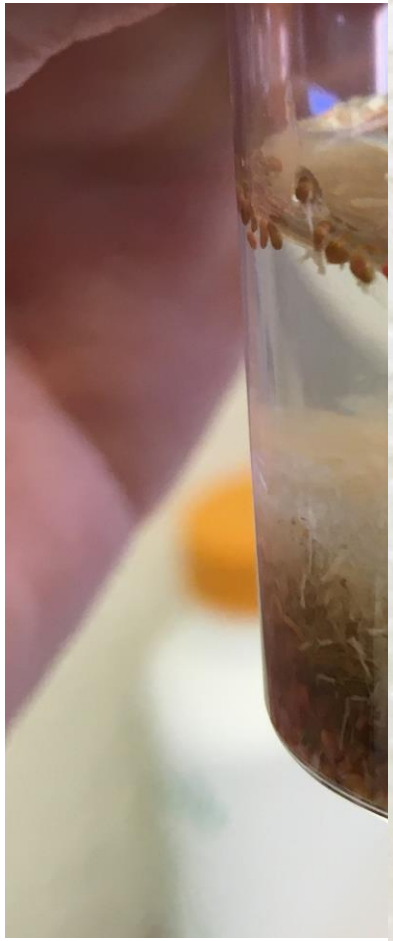
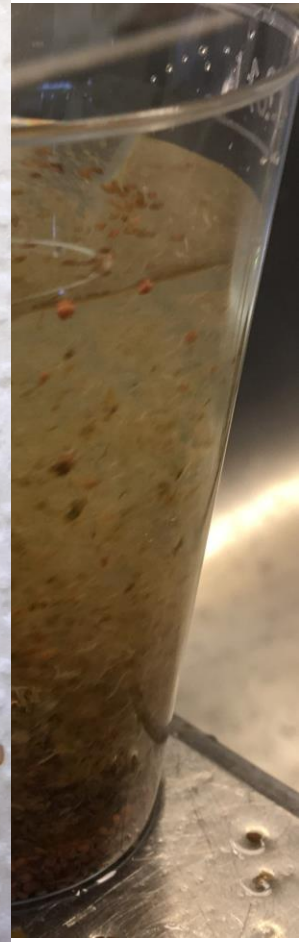
Example from practice

Example from practice





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Example from practice

Carrot Juice

Poor filterability with remarkable turbidity stability

- Carrot juice for manfucaturing of colour concentrate
- Juice must be easy to filter and concentrate!
- First clue: customer reports difficult pectin degradation

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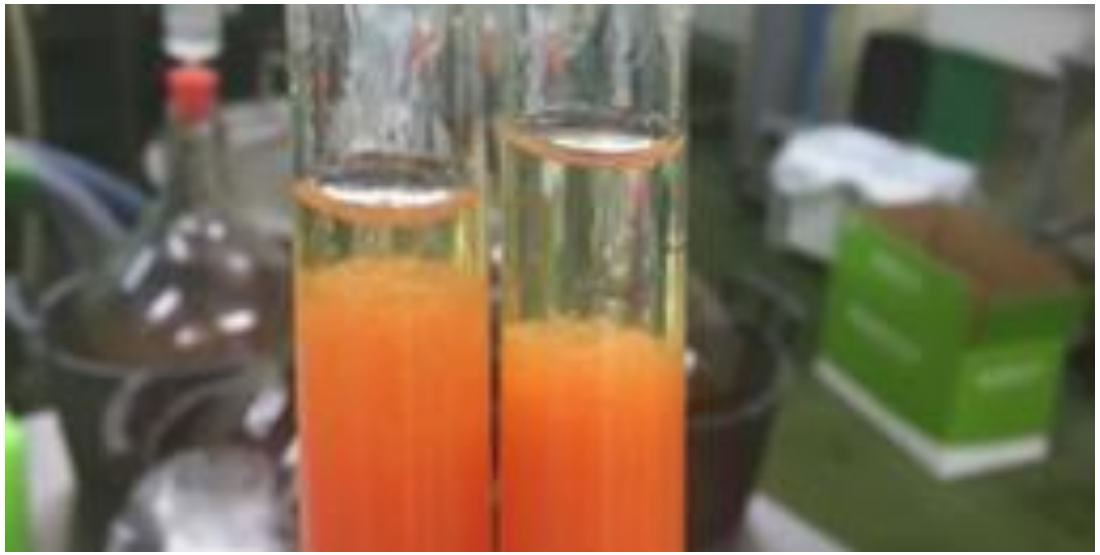
Example from practice

Carrot Juice

- Different variants of pectin detection tested
- Variant with ethanol layering shows the best results



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Example from practice

Carrot Juice

- Tests with silica sol showed strong reactions
- Additional centrifugation leads to rapid clarification

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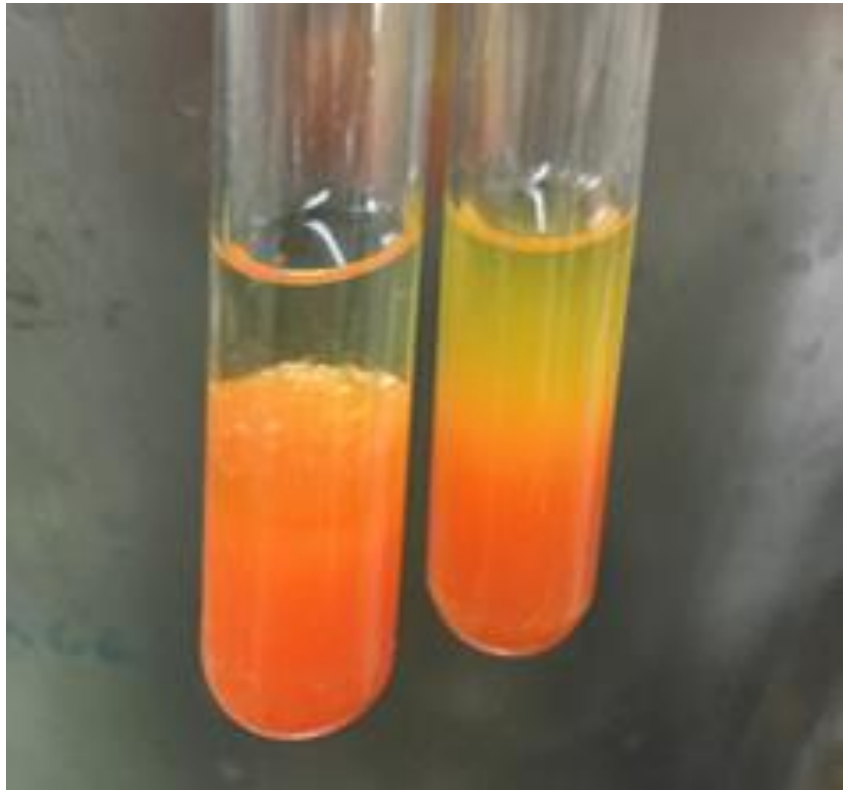
Example from practice

Carrot Juice

- Usual application temperatures of >50 °C proved to be unsuitable
- Adjusted temperature of 45 °C showed success after a short reaction time
- **Customer successfully took up the recommendation**



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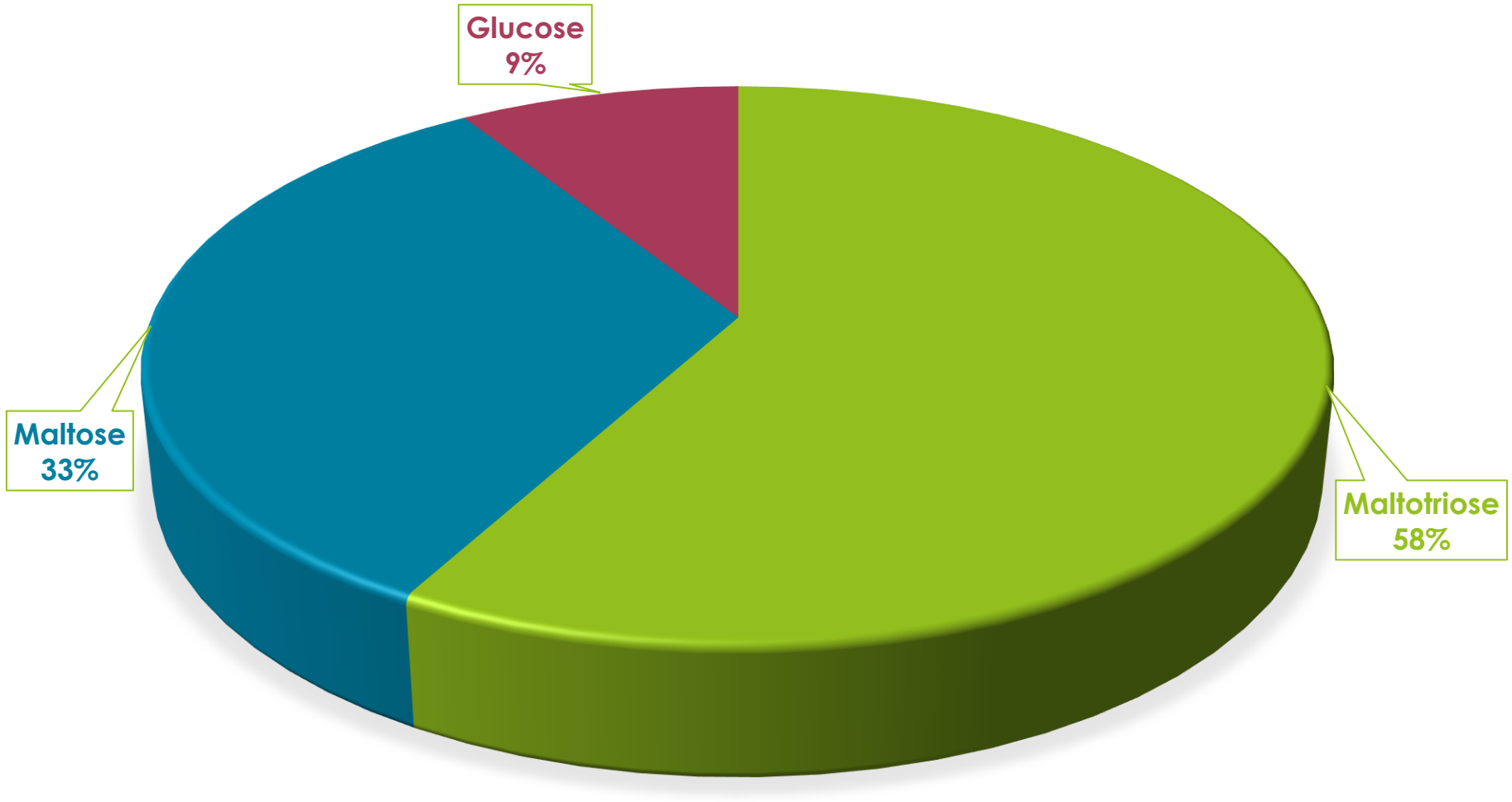

Enerzym Amyl 300 ppm
Enerzym Visco 10 ppm

Enerzym Alpha 800 ppm

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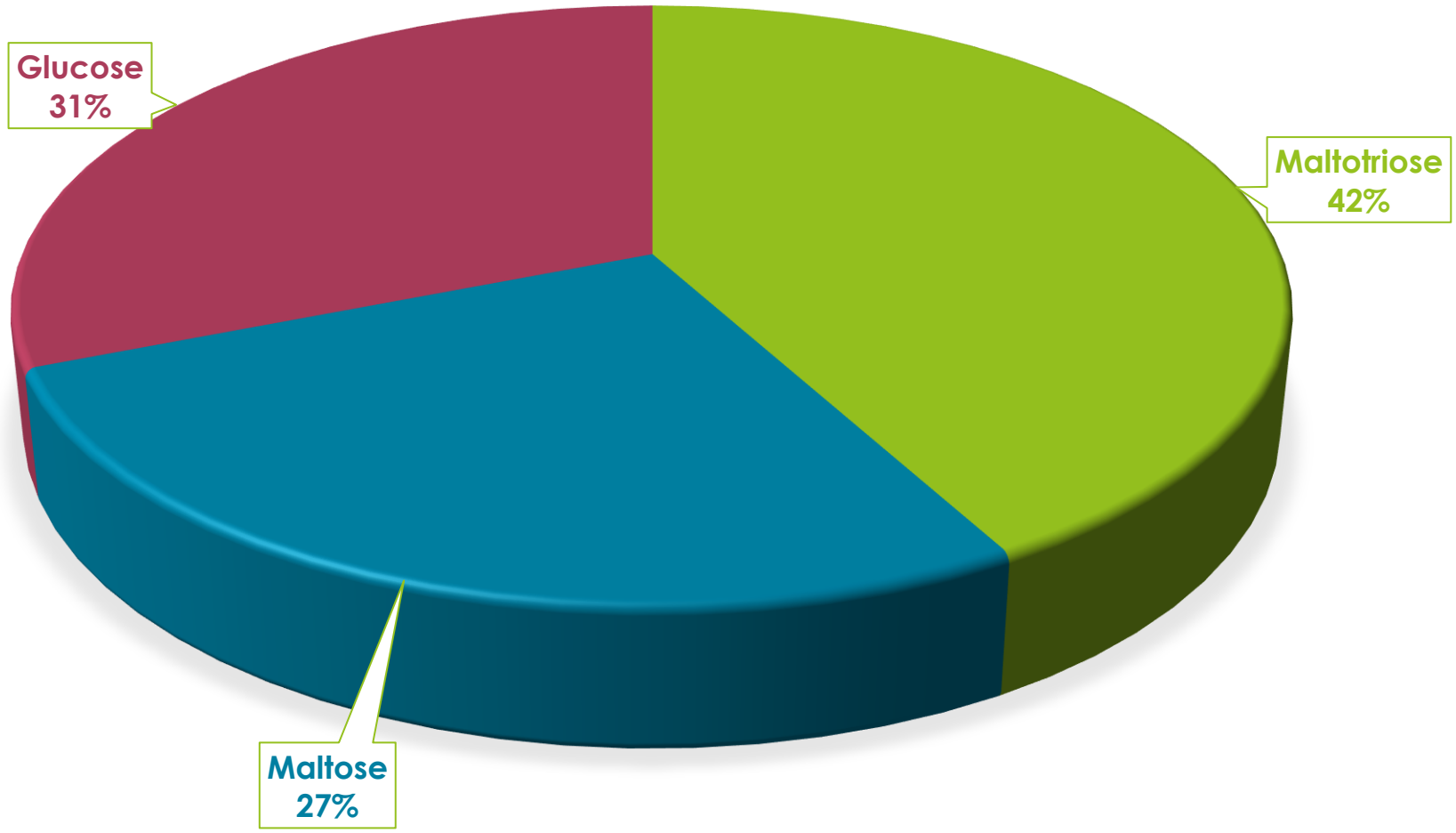

Enerzym Amyl 300 ppm
Enerzym Visco 10 ppm

Enerzym Alpha 560 ppm
Enerzym HT 240 ppm

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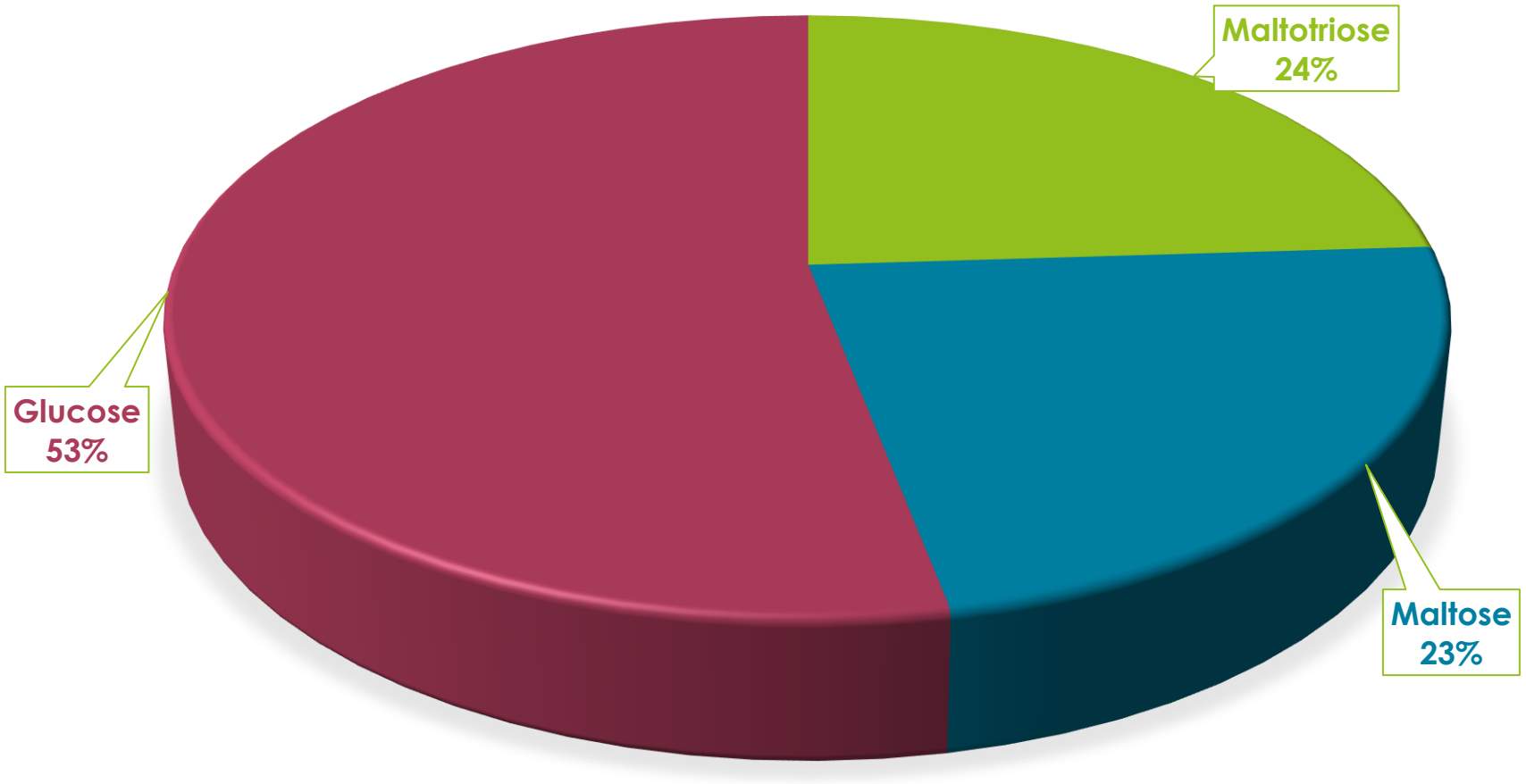

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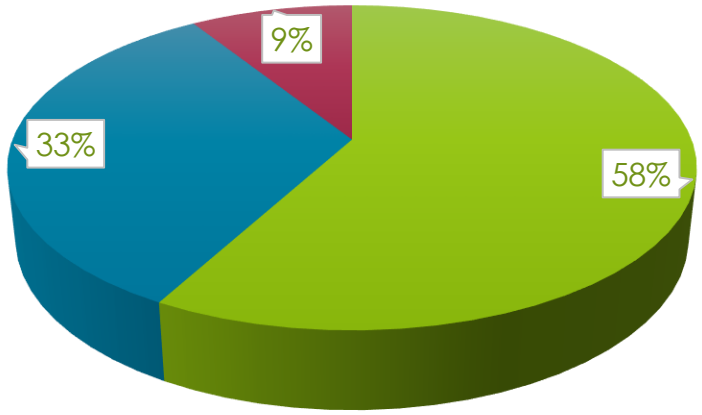

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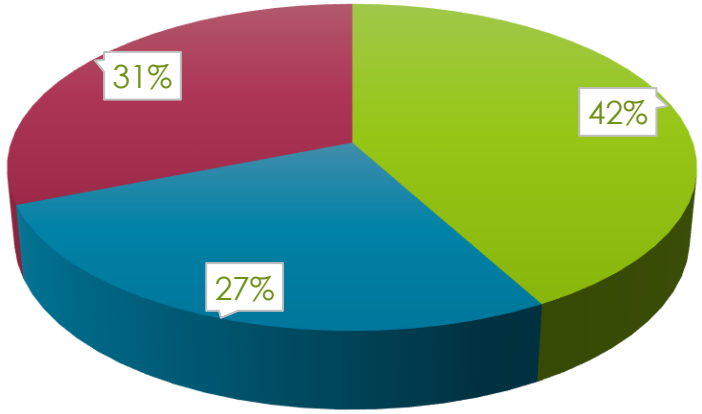

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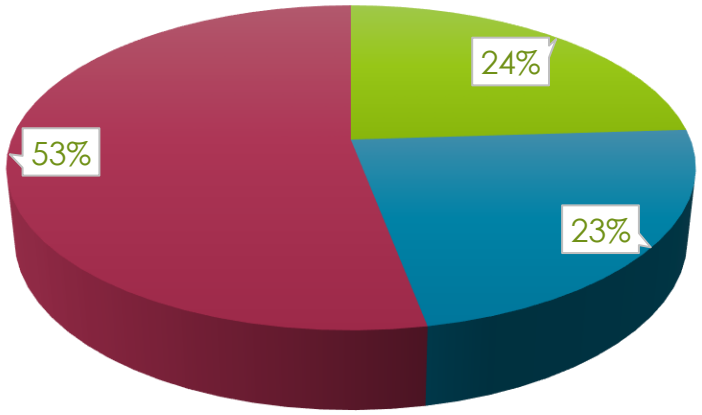


Recent trends in production of cloudy apple NFC

BUCHER unipektin

Dr. Edgar Zimmer
Head of Technology and Development

Public

Cloudy NFC - Targets and Challenges

Targets

- Highest A-juice yield
- Low oxidation / light colour with low vitamin C consumption
- High stability of cloudiness
- Seasonal and all year round processing (fresh and stored apples)

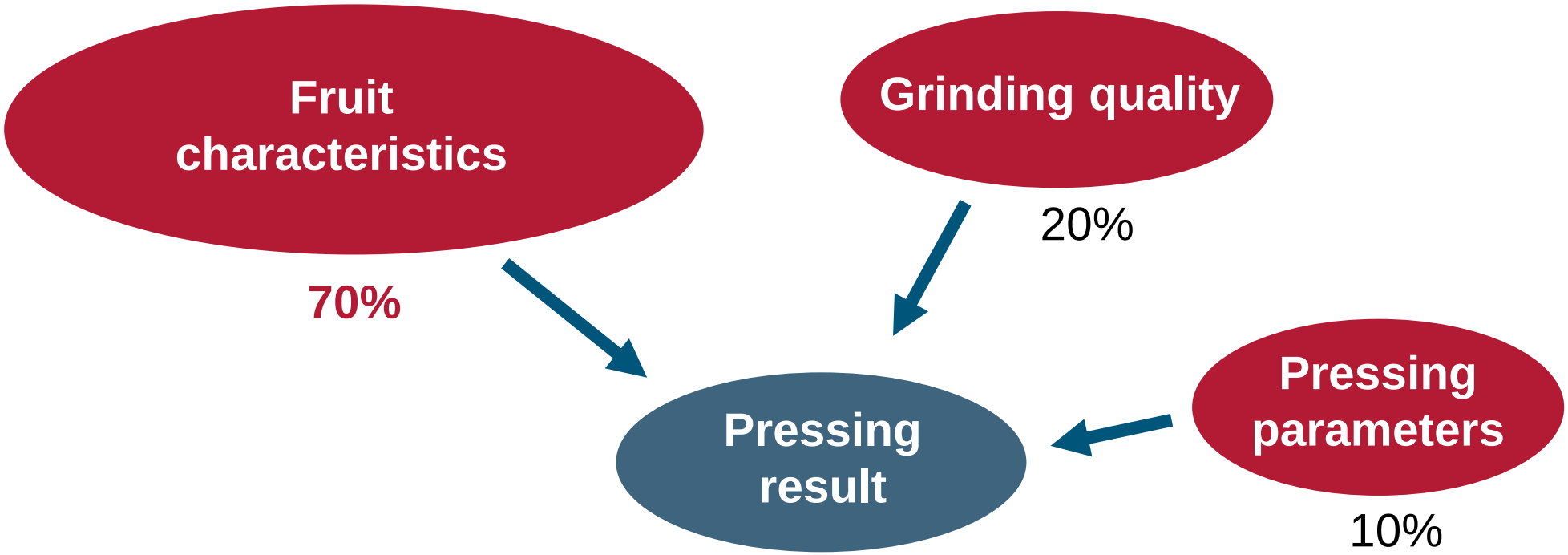
Challenges

- High A-juice yield vs. juice quality:
  Mash enzymation and long pressing cycles have negative impact on juice quality (colour, sedimentation stability)
- Flexible technology, usable for fresh and stored apples

Challenge: Fruit Quality

Impact on press capacity and yield

<u>without</u> mash enzymation



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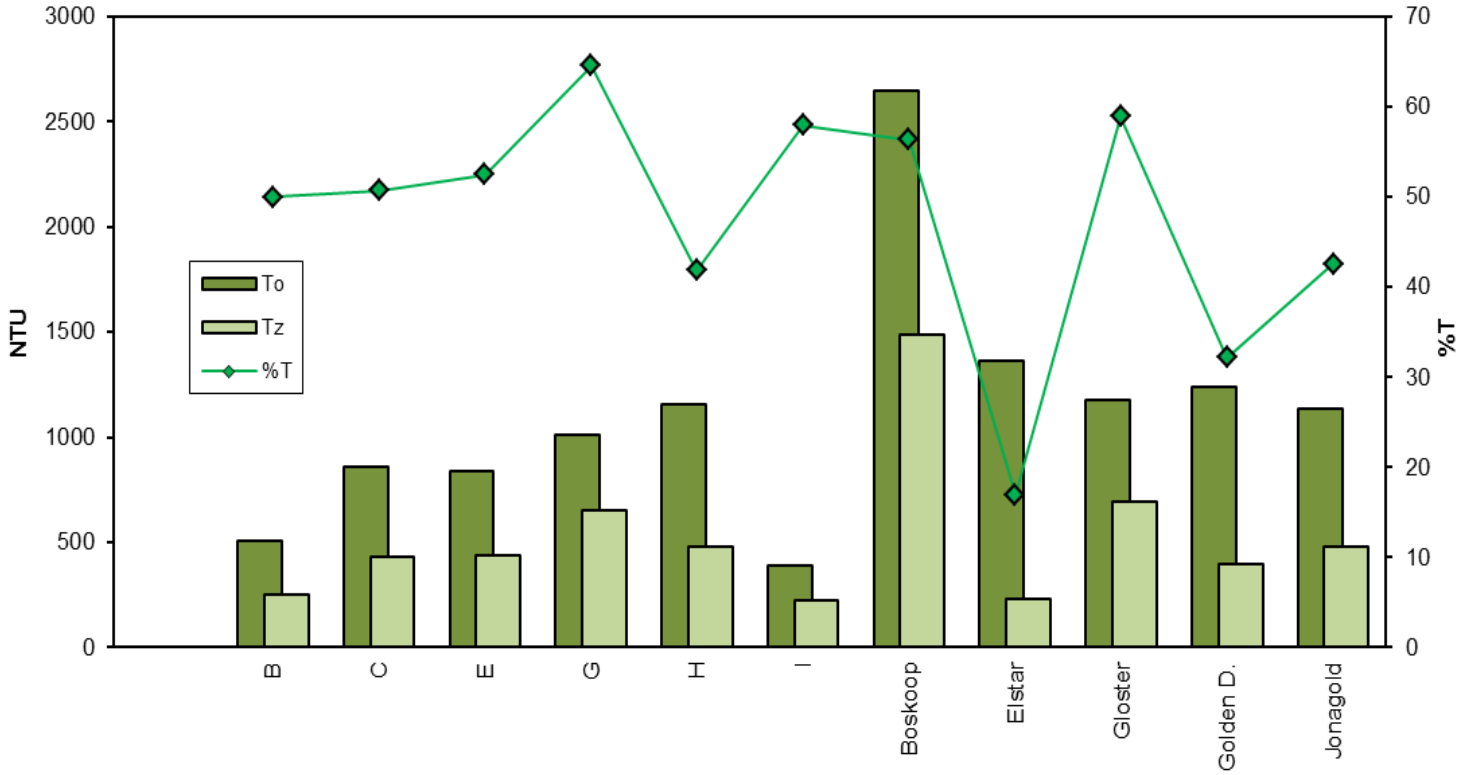
Challenge: Fruit Quality

Impact on cloudiness and sedimentation stability



In a study with 11 apple batches (6x blends, 5x single variety) the total turbidity T_0 varied from 390 to 2'646 NTU with identical processing !
The stable turbidity T_z varied between 226 and 1'491 NTU !

BUCHER unipektin

Challenge: Fruit Quality

Impact of fruit characteristics

- Apple variety, ripeness, starch content and storage time have a major impact on the cloudiness and sedimentation stability
- Generally: fully ripe apples generate higher and more stable turbidity compared to less ripe fuit
- Apple varieties can have good or bad turbidity potential
  → mixtures recommended (compensation)
- Only sound apples shall be processed; enzymes deriving from microorganisms deteriorate sedimentation stability !
- Starch (retrograded) is undesirable as it forms a sediment and greyisch hue
  → starch should be separated by a centrifuge prior to pasteurisation !

The raw material has the decisive impact on the cloudiness and sedimention stability !

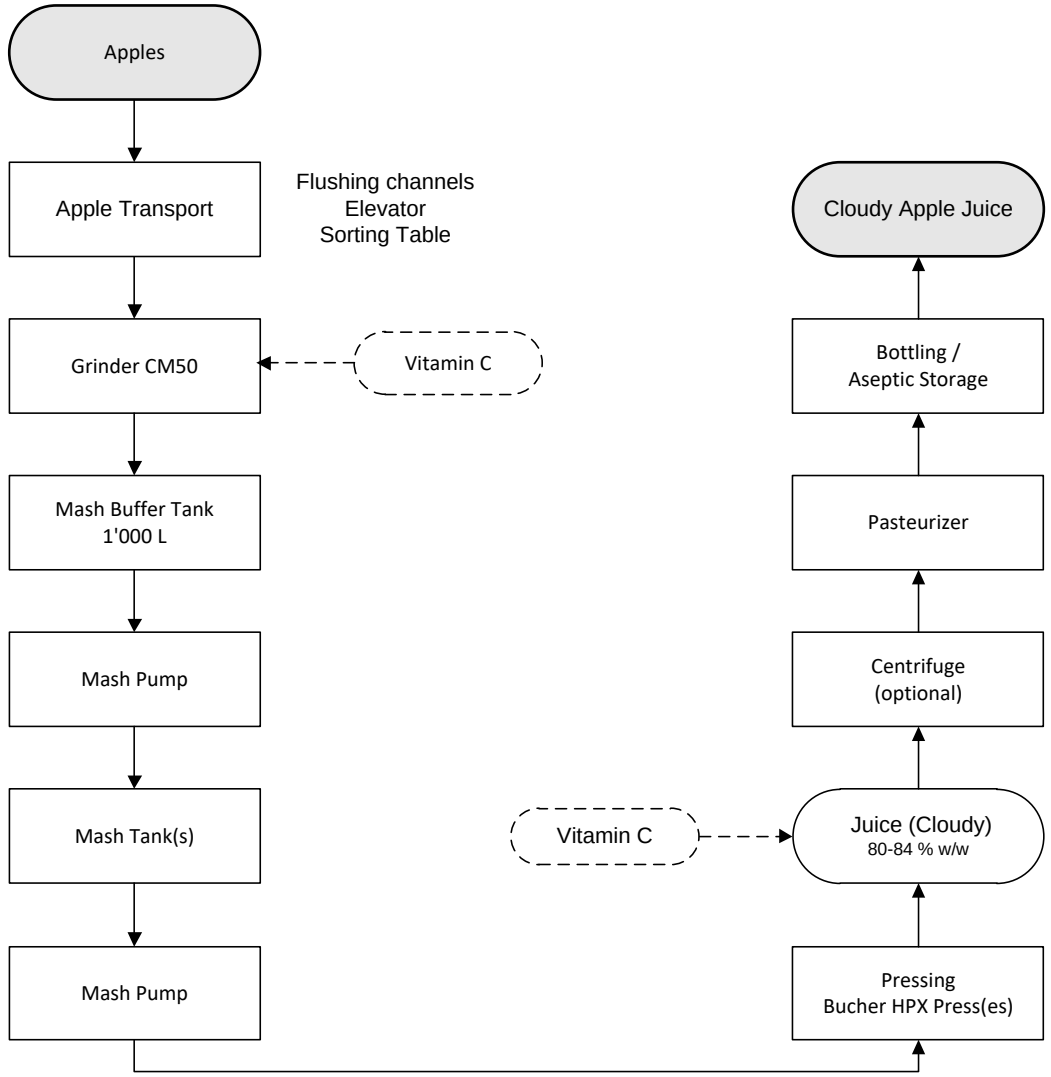
Traditional Process

Disadvantages traditional process:

Long processing time:
→ high VitC addition required for preventing oxidation (300-800 mg/L)
→ high VitC losses (oxidation, loss with pomace)

With stored apples and/or plenty of VitC:
→ bad mash pressability
→ low yield and throughput

With 2-step process (A + B juice):
→ **B juice (concentrate) turns dark due to VitC**



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Recent Processing Strategies

Single step process

- Widely used for small to medium size operations (AJC production from B juice not economical)
- High A-juice yield is a “must have” for profitable operation → trend to hydraulic presses

Fast process – short time between grinding and pasteurisation

- no mash enzymation, low oxidation, high sedimentation stability
- Bucher **“direct filling”**: well suited for fresh apples

Processing of stored / soft apples

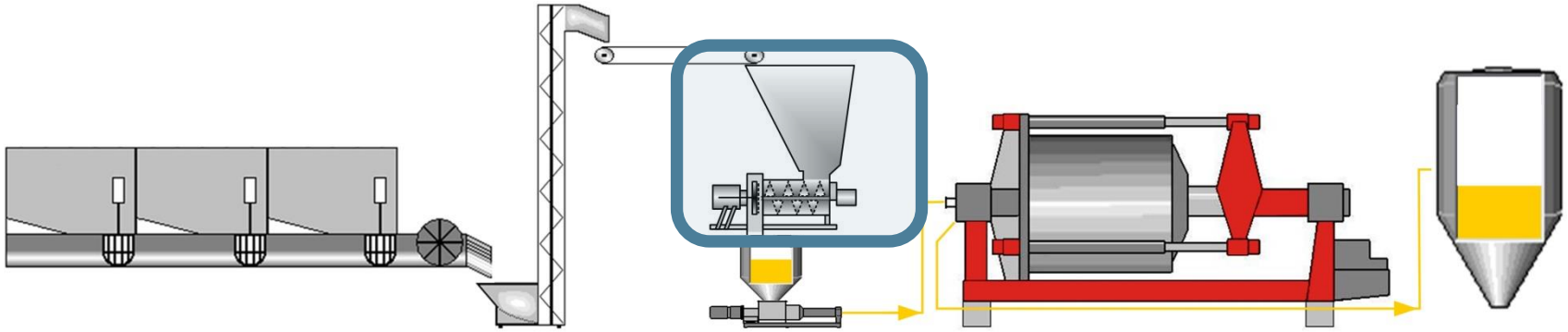
- W/o mash enzymation: good juice quality but low yield and throughput
- With special mash enzymes: **slight well controlled mash enzymation** is possible with acceptable juice quality

Grinding

- For fresh apples: small particles / high degree of disintegration recommended

Direct Filling

Apple buffer

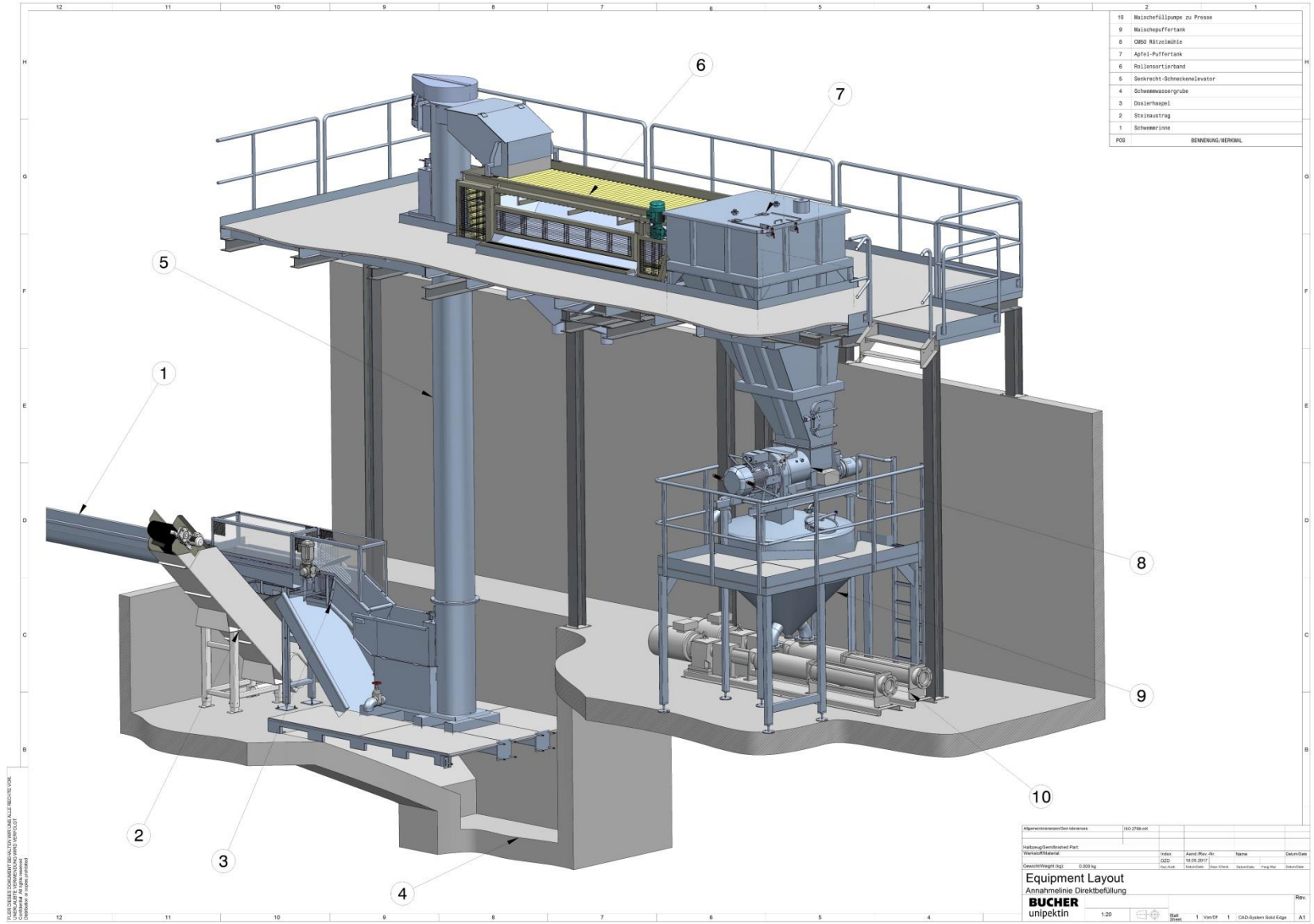


Apple buffer replaces mash buffer

- Grinding with Bucher CM50 grinder: up to 50 t/h capacity
  → virtually no loss in throughput despite small mash buffer
- **Direct filling** of the press(es) from the small mash buffer tank (1’000 - 3’000 L) underneath the grinder
  → mash holding time < 1 min possible
  → no or minimal VitC addition to mash, standard VitC addition to juice (reduced consumption)
- Standard pressing times (45-60 min) and yields possible (up to 85 % w/w)
- B juice (optional) can be used for AJC production; no increased browning due to virtually no VitC in B juice

Direct Filling

7: Apple buffer, ca. 3 m3
8: CM50 grinder
9: Mash buffer tank, 1-3 m3
10: Filling pumps, flow controlled



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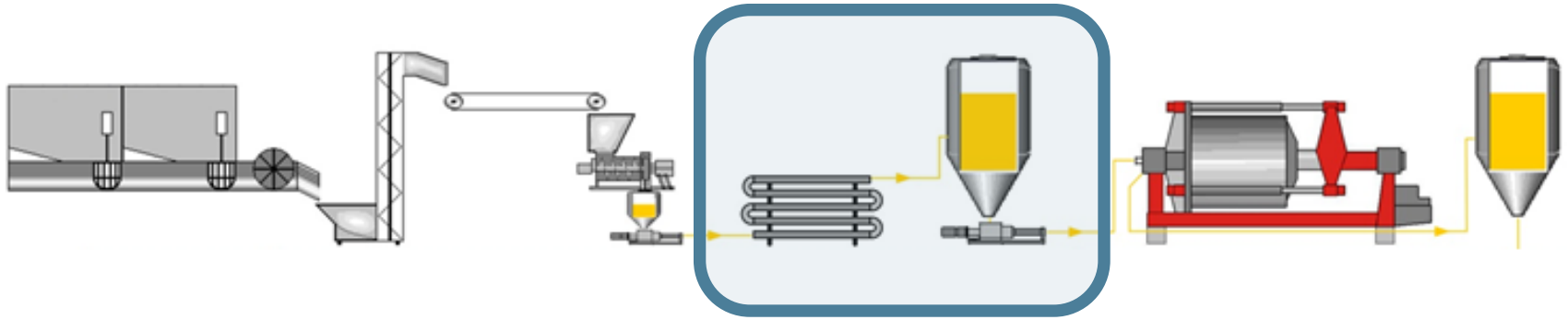
NFC from stored apples



- Standard line design with mash tank (battery)
- Optional mash heater (if apples come directly from cold store)
- **Very well controlled mash enzymation** (enzyme dose, temperature, holding time), special mash enzyme (low hydolysing side activities)
- Pasteurisation as quickly as possible after juice extraction

→ improved yield and pressing capacity
→ reduction of sedimentation stability often acceptable

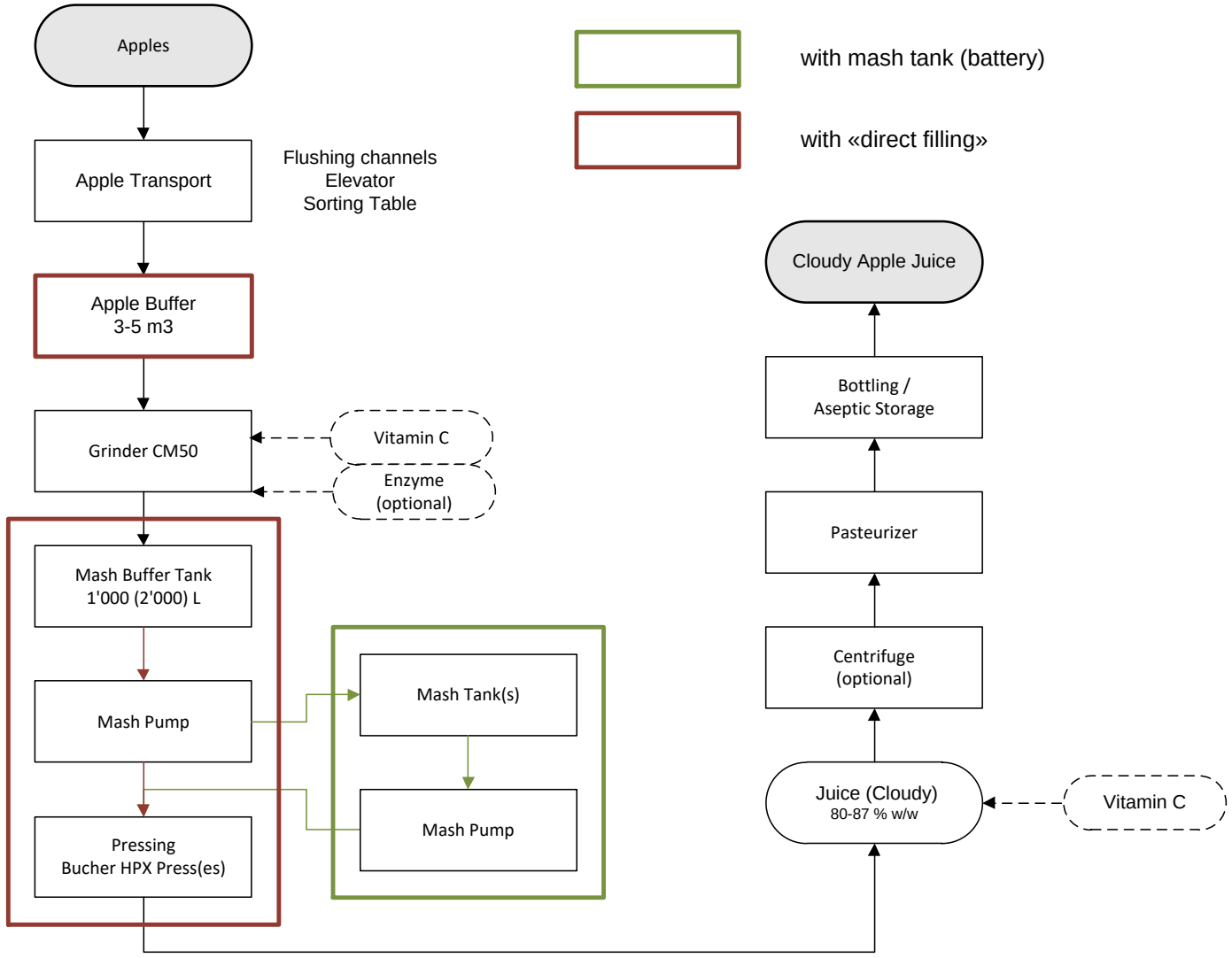
With mash enzymation the sedimentation stability always will be reduced !
If juice quality specs still can be met it can be very profitable anyway.

Recommended NFC Processing Options

“Combined” Process:

Maximum flexibility:
Standard, direct filling and mash enzymation are possible

Depending on season / fruit quality the optimum process can be chosen



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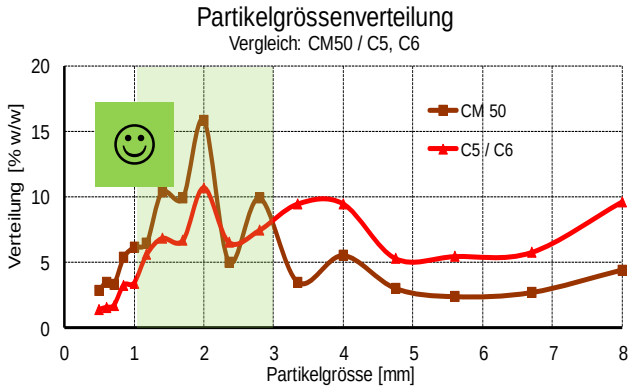
Grinding system

Targets

- optimum mash structure for all raw materials (hard vs. soft)
- low oxidation, low incorporation of air
- high grinding capacity, in particular for “direct filling”



Recommended: Bucher CM50 grinder

- highest share of particles in the optimum size range 1 – 3 mm
- several options for adjusting mash structure (speed grindig disc, width discharge slot, toothing of knives, speed feed auger)
- high grinding capacity up tp 50 t/h
- low oxidation

Mash from CM50

Mash from hammer mill

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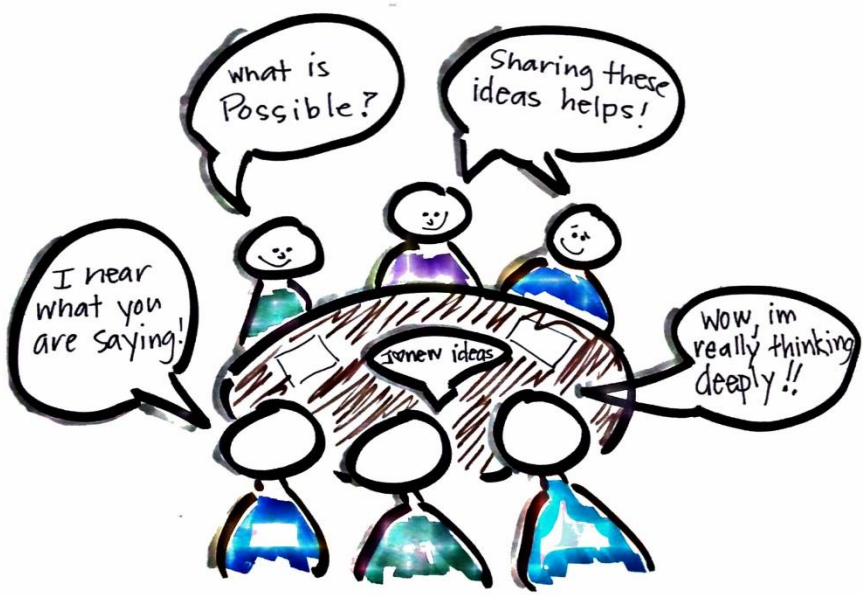
Summary

- The suitable process technology is always a compromise between juice quality and economical requirements (yield, throughput)
- A combined A and B juice process is often not economical for small and medium sized operations; if an AJC line is operated in parallel it can be very profitable
- For fresh apples the “direct filling” of Bucher HPX presses often is the best choice for yield, juice quality and VitC consumption
- Processing of stored apples is increasing; a well controlled mash enzymation with special pectinases can be a preferred compromise between juice quality and profitability
- An ideal processing line allows the flexible adjustment of the process to varying raw materials and targets
- A good grinder with optimal mash structure and low oxidation is beneficial for all process options

Thank you !



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Particularities of Serbian autochthonous apples in processing

Vladimir Šušnjar, Prehteh d.o.o.

When the standard no longer suffices

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When the standard no longer suffices

Agenda

- Special varieties – Special treatment
- Mash treatment
- Juice treatment
- Fining, Stabilization and Filtration
- Process Control
- Special Case: Juice from damaged fruits
- Conclusion

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Special varieties – special treatment

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Special varieties – special treatment

The apples are grown in the hillside of Serbia (no orchards)

- Typical Serbian varieties are:
  - Bela-Kolačara
  - Budimka
  - Pogačara
  - Kožara
  - Lederica
  - Petrovača

Similar challenges for:

- Meadow orchards
- Cidre-/cider-bittersweets
- Autochthone varietys

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Mash treatment

Challenges are:

- Hard apples → Pectin structure
  - Yield Problems
- Soft apple/Fine mash structure → Poor drainage
  - Yield Problems

➢ Optimization of mash handling

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Juice treament

Challenges are:

If not treated properly, a multitude of issues can follow.
Fining and filtration problems are often enzymation problems!

- High pectin levels in juice
  - Complete depectinisation
- High starch content
  - Complete degradation of starch
- Higher levels of hemicellulose
  - Low filter flux and risk of araban haze
- High Polyphenol content
  - Chill haze formation during storage

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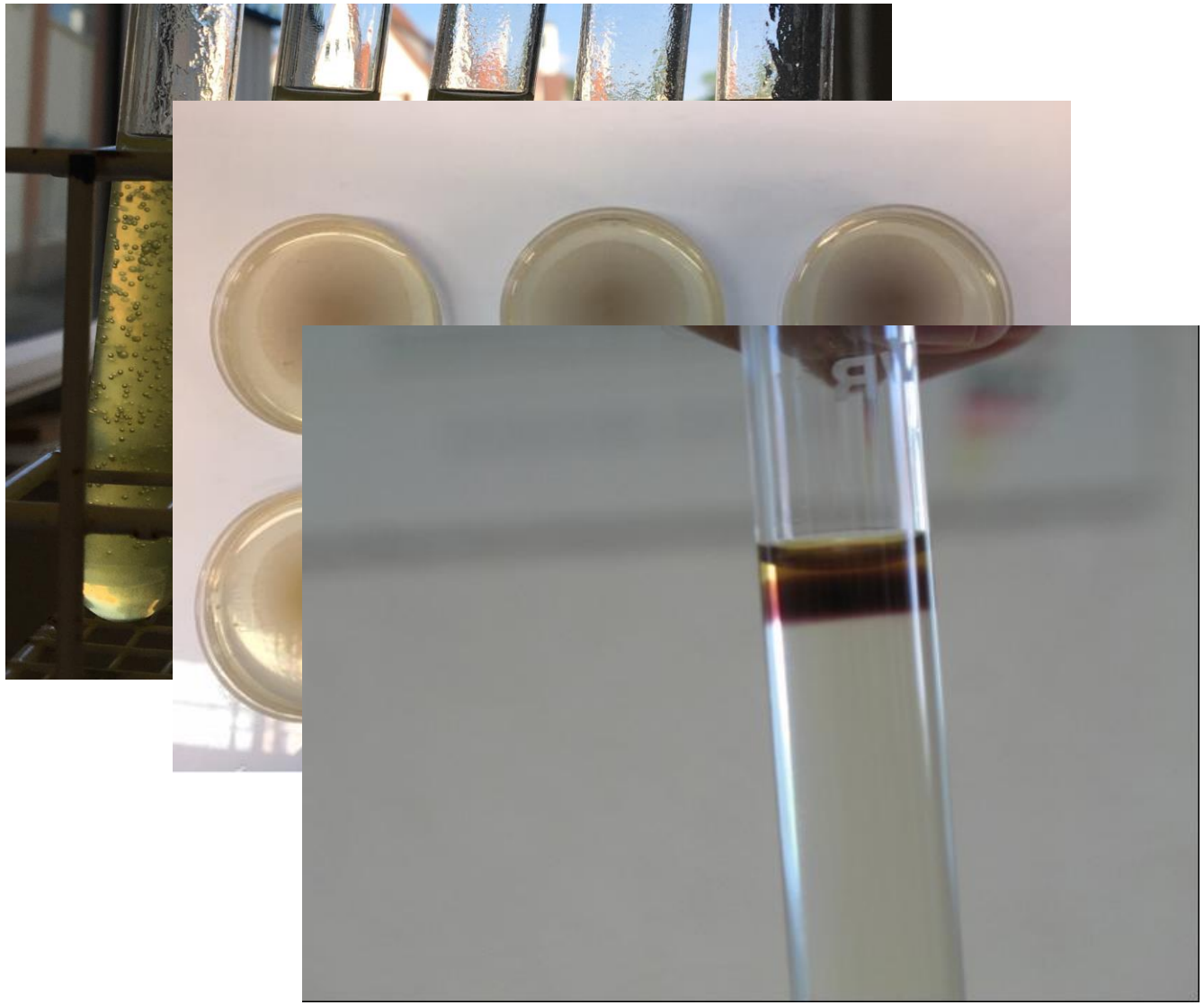
Juice treatment

Quality check:

- Juice 100 % pectin free
- Low starch levels are often difficult to detect
- Modified starch test for 100 % absence of starch (>80 °C heating mandatory before test)



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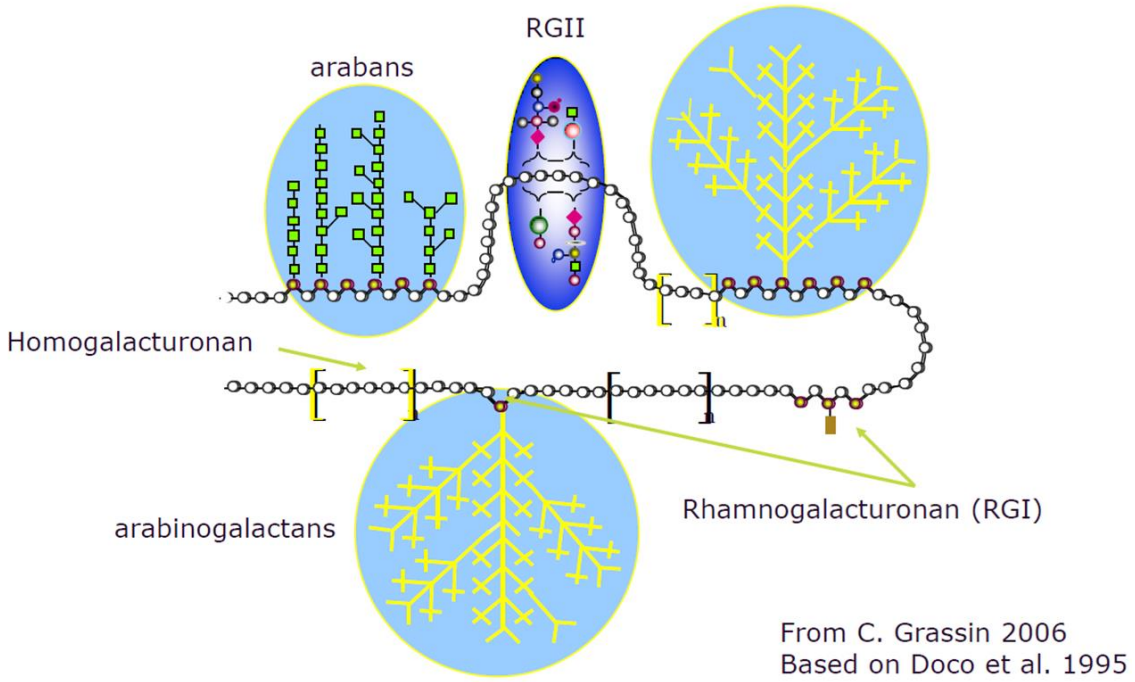
Fining & Stabilisation, Filtration

Again:
Fining and filtration problems are often enzymation problems!



From C. Grassin 2006
Based on Doco et al. 1995

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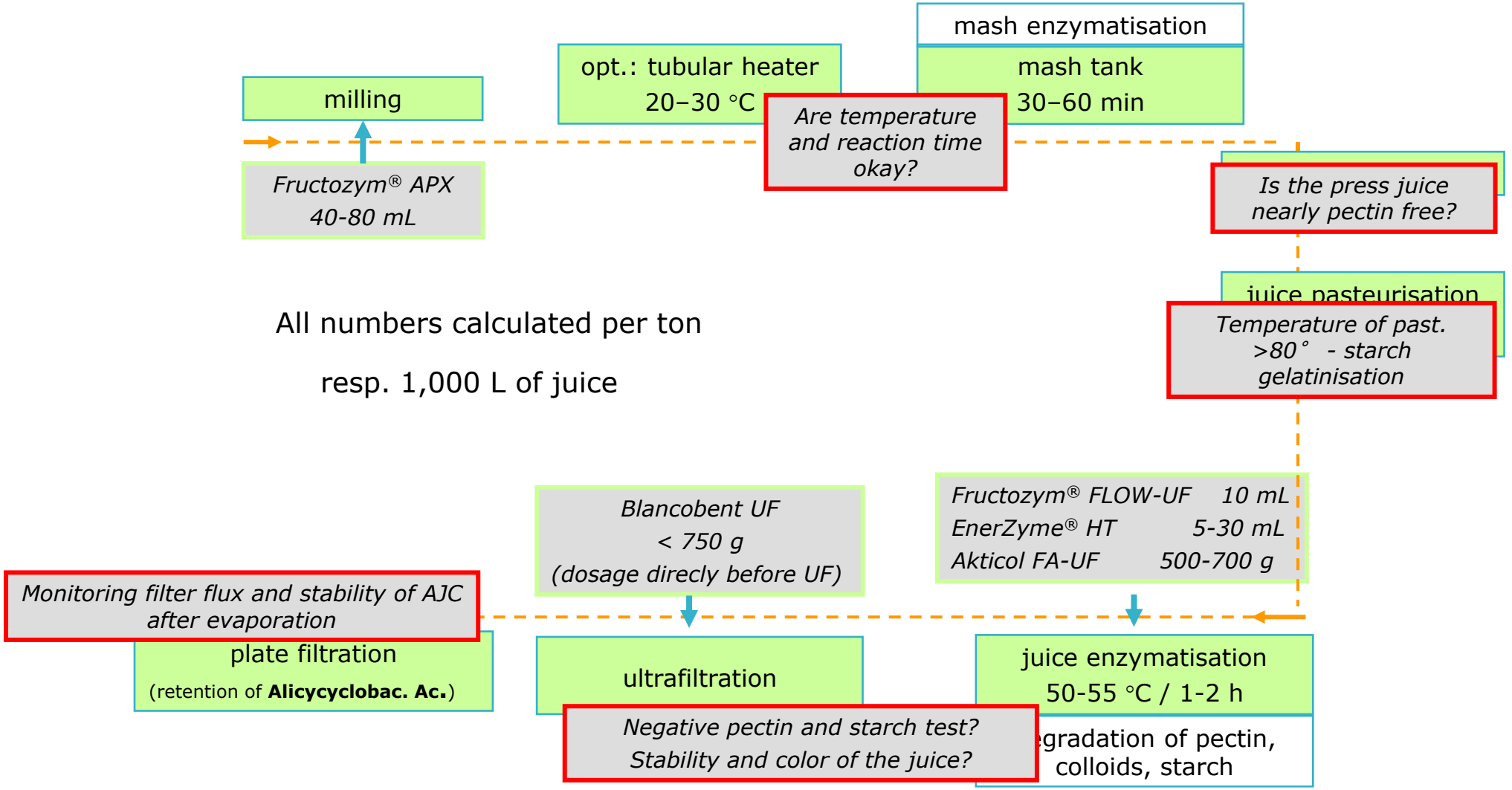
Process Control



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Special Case: Juice from damaged fruits

Challenges are:

- **Oxidised juice**
- Prevention & Stabilisation → Ascorbic acid (*Ercobin*)
- Colour reduction → *Akticol FA-UF, Ercarbon FA*
- Colour stabilisation → *Ercarbon SH*
- Corrections by precoat filtration → *Granucol FA (less dust)*

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Special Case: Juice from damaged fruits

Challenges are:

- **Mycotoxins**
- Stabilisation of minor patulin and ochratoxin contents → Ercarbon SH

- **Sensory polishing**
- Removal of slight off-flavours → Ercarbon SH
- Reduction of polyphenols → FloraClair, Ercarbon FA

- **HMF**
- Reduction of HMF in reworked AJC → Ercarbon SH

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Conclusion

Mash treatment

- Classical enzymes with side activities improve pressing
- ✓ Fructozym® APX

- Cellulose fibres improve mash drainage
- ✓ CelluMash

Starch

- Alpha-Amylase and/or double pasteurization improve starch degradation
- ✓ Enerzym ® Alpha

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Conclusion

- **Pectin**
  - Successful fining requires degradation of pectin (protective colloid)
  - ✓ Fructozym® P and P6XL
  - Pectinase with a broad spectrum of side activities improves stability and filterability
  - ✓ Fructozym® Flow UF
  - ✓ Fructozym® Flux

- **Polyphenol adsorption**
  - Fining agents reduce colour and improve stability
  - ✓ FloraClair ® (pea protein)
  - ✓ Akticol FA-UF, Ercabon FA, Granucol FA, Ercabon SH (activated carbon)

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Conclusion

Protein adsorption

- Fining agents remove proteins for improved stability and filtrability

✓ Blancobent UF (bentonite)

✓ KlarSol Super, KlarSol 30 (silica sol)

✓ Tannivin Galleol (tannin)

Thank you and cheers!

Questions?

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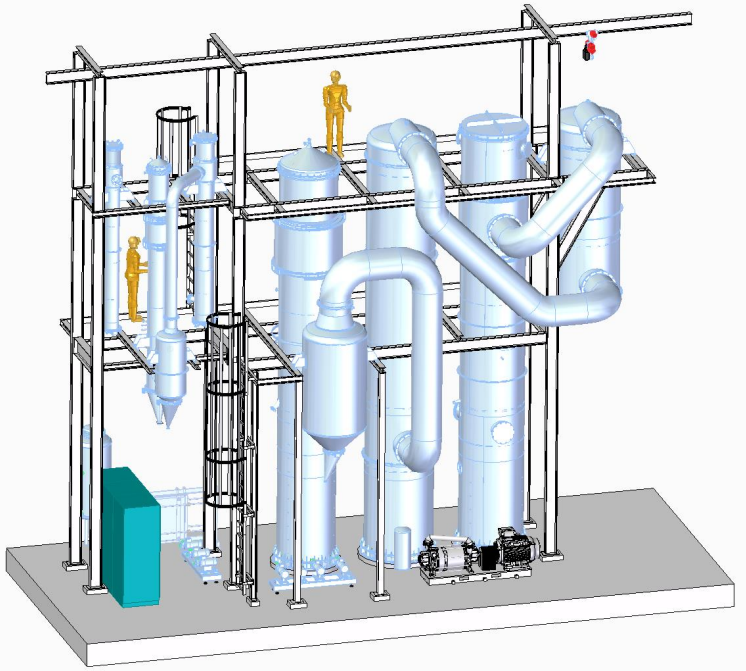
Technology of Dealcoholisation

BUCHER unipektin

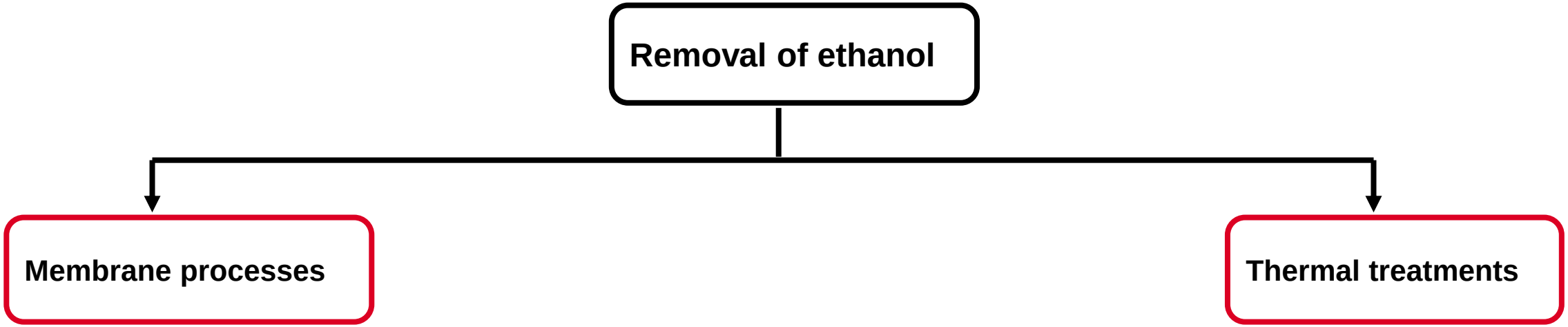
Dr. Michael Welte
Head of Process Engineering

Public



Dealcoholised and alcohol-free product

Methods of dealcoholisation in comparison



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Dealcoholised and alcohol-free product

Methods of dealcoholisation in comparison

Membrane processes

Reverse osmosis

- ✓ product is treated at low temperature
- − Need of diafiltration water
- − Difficult < 0.5 % ethanol

Nanofiltration / Pervaporation / Dialysis

- ✓ Dealcoholisation is performed at low temperature
- − Aroma losses
- − Need of diafiltration water
- − Low and varying flowrates
- − 0.0 not possible

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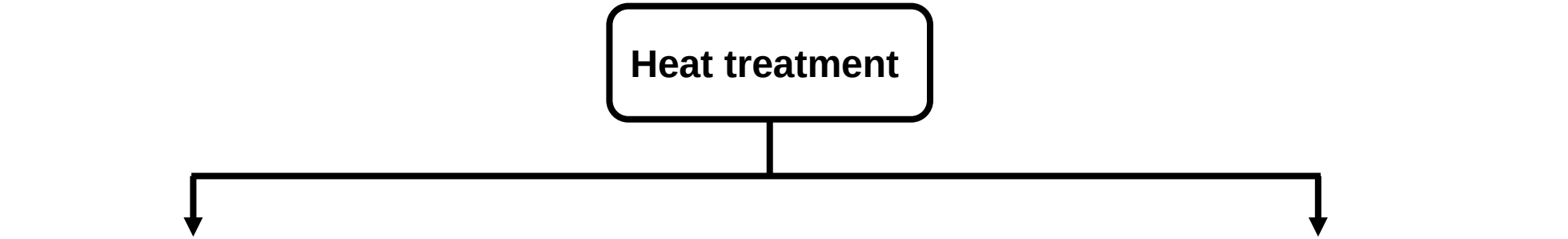
Dealcoholised and alcohol-free product

Methods of dealcoholisation in comparison



Vacuum evaporation

- Allows ethanol content of 0.02 % v/v
- Filtered and unfiltered product
- Standard 0.0 “basic fruit wine” / diversity
- Thermal impact is minimised
- Aroma recovery
- Alcohol rectification
- Need of an additional machine (evaporator***)***

Spinning cone distillation

- Allows ethanol content of 0.05 % v/v
- Thermal impact is minimized
- High energy costs

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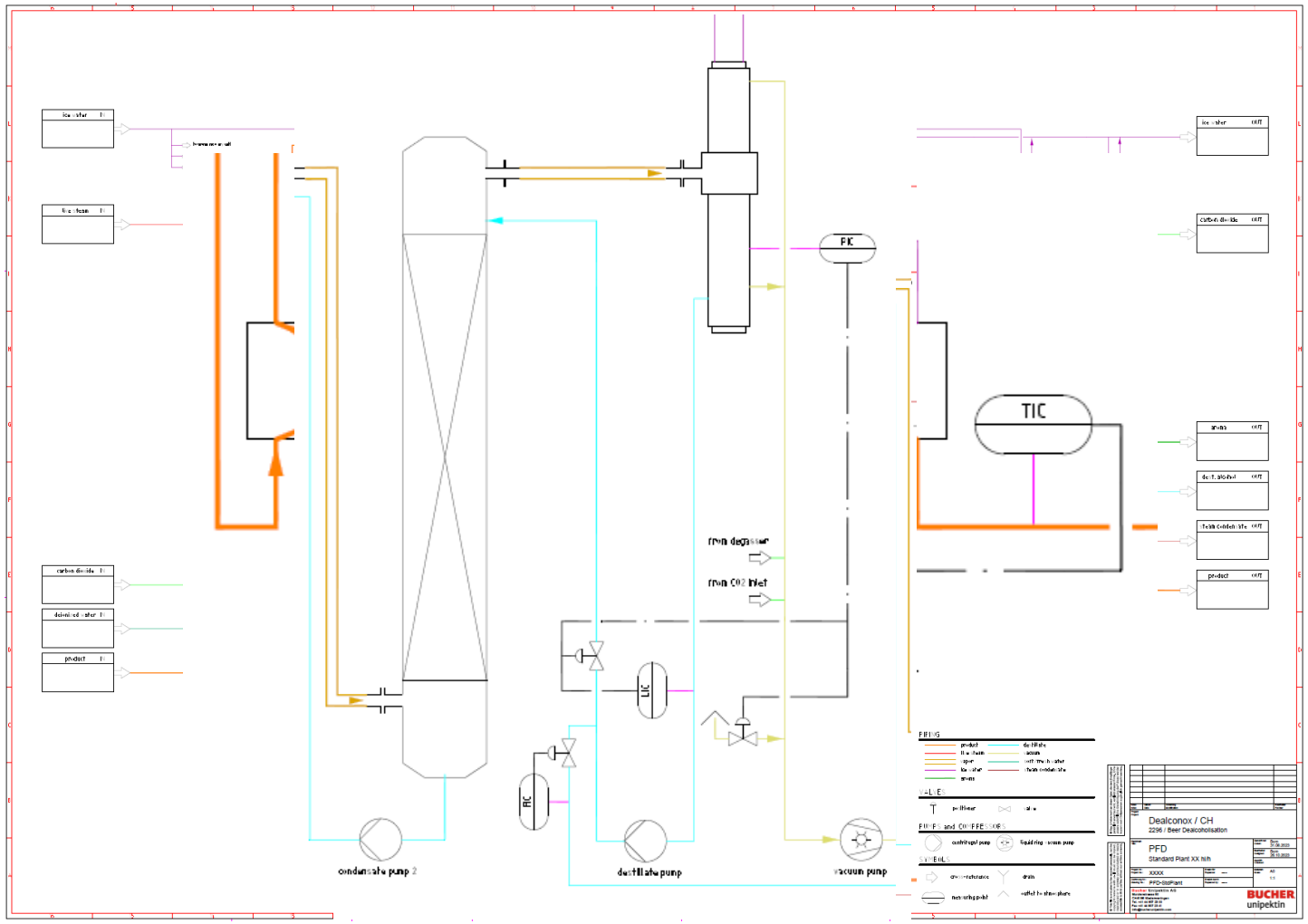
Dealcoholised and alcohol-free product by DE-ALCONOX B

Principle of thermal dealcoholisation



1. Preheating of the ingoing flow with outgoing product
2. product heating with life steam to degassing temperature
3. CO2 degassing
4. Alcohol stripping with vapours from the evaporator body
5. Alcohol rectification
6. Cooling of the dealcoholized product against ingoing flow and glycol

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Dealcoholised and alcohol-free product by DE-ALCONOX B

Our offer in detail

Thermal dealcoholisation with DE-ALCONOX:

- Removing of alcohol in a gentle way from fruit wine
- Alcohol removal < 0.02 % v/v
- Maximum temperature of product < 39 °C
- Continuous flowrate regardless of inlet product
- In-line de-gassing
- Option: Column for rectification (alcohol concentration)
- Option: Column for aroma recovery

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Dealcoholised and alcohol-free products by DE-ALCONOX B

Why Bucher Unipektin?

Bucher Unipektin is manufacturing evaporators and aroma recovery systems since more than 70 years

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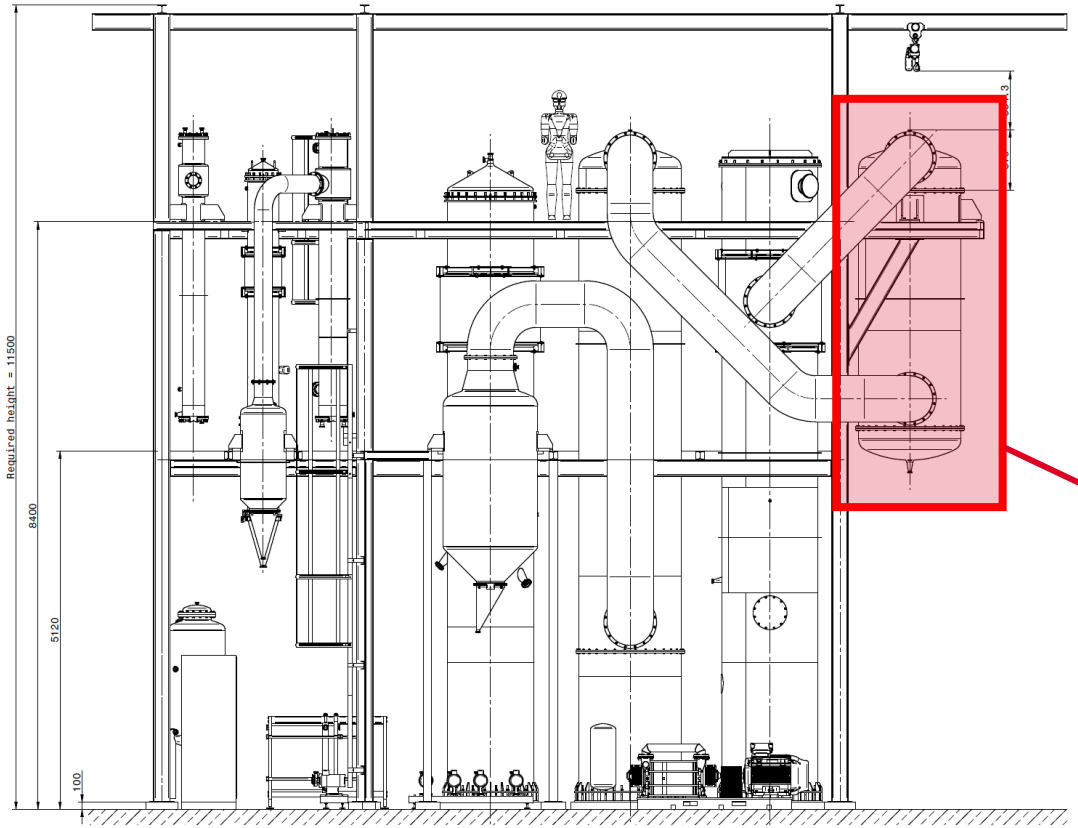
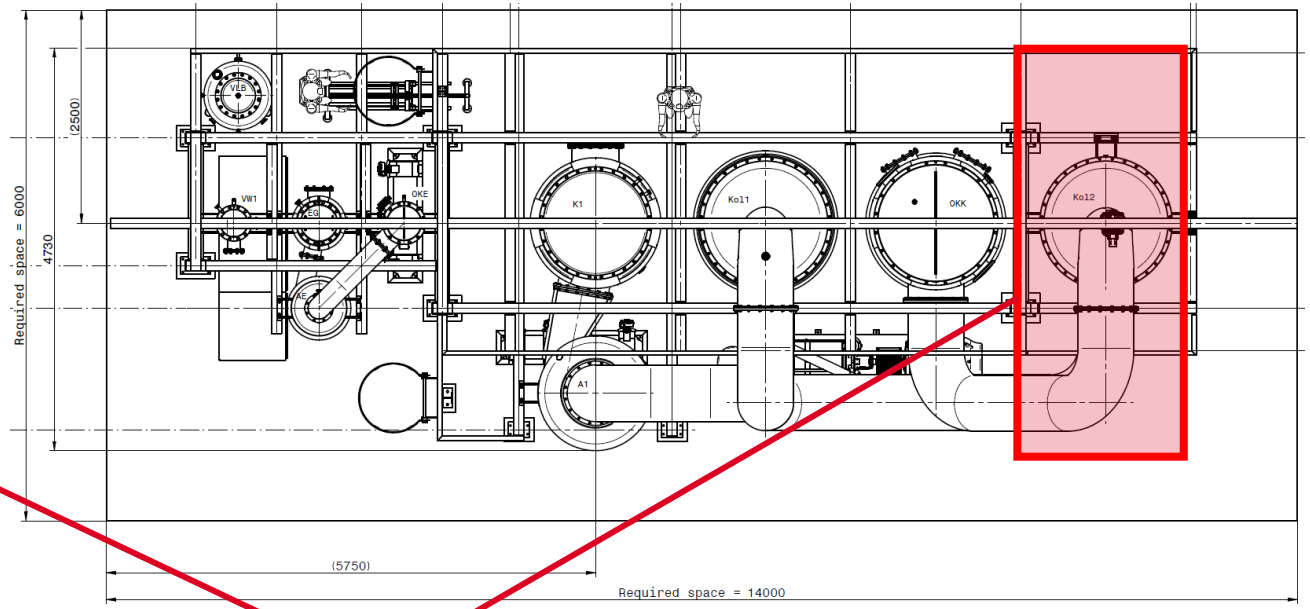
Dealcoholised and alcohol-free product by DE-ALCONOX B

Layout of a 100 hl/h plant (similar for plants from 12.5 – 200 hl/h)





Optional Rectification

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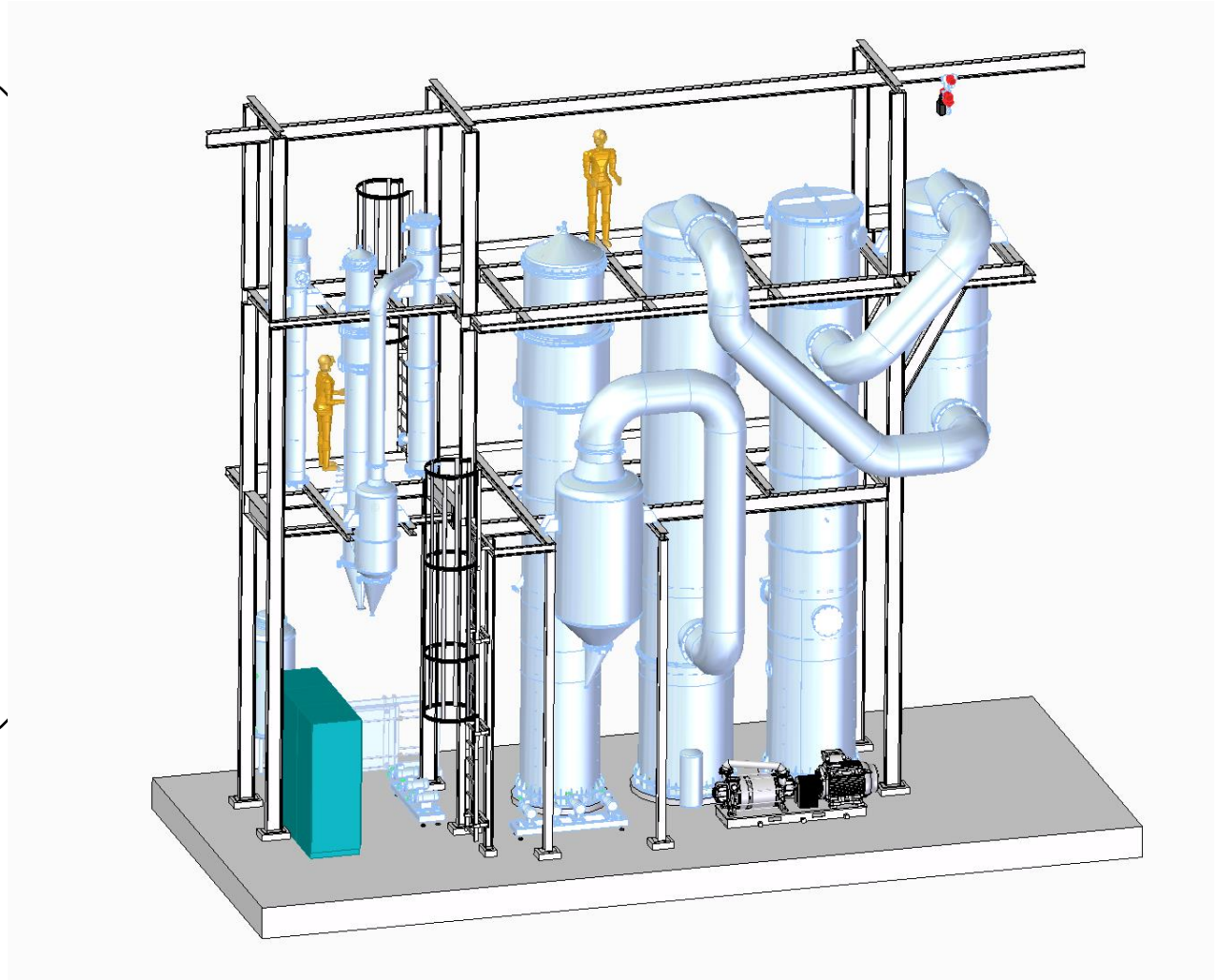
Dealcoholised and alcohol-free products by DE-ALCONOX B

Utilities DE-ALCONOX B

Main required utilities like:

- ✓ Steam (1’192 kg/h for 50 hl/h)
- ✓ glycol and or ice water (814 kW for 50 hl/h)
- ✓ Electricity consumption (23 kW utilized for 50 hl/h)



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Test plant deacoholisation

Automated test plant available on site at customer or in Bucher Unipektin, Switzerland

- Feed flow approx. 2-3 hl/h
- Feed alcohol concentration < 7 % v/v
- Outlet alcohol concentration 0.03 – 0.5 % v/v
- Outlet alcohol concentration 60 – 80 % v/v
- Main utilities: deionized water for start up (3 hl/h), steam (production) up to 65 kg/h, electrical connection 28kW
- Space (l x w x h) 4.1 x 2.0 x 5.3 m
- Weight skid 1: 2.5 t, skid 2: 3.0 t
- Options available: steam generator, carbonator

Dealcoholised and alcohol-free product by DE-ALCONOX B

Advantages DE-ALCONOX B plants

- Suitable for **filtered** or **unfiltered** products
- **Degassing** within seconds (no recirculation) **to ≤ 0.1 gCO_2/l**
- Dealcoholisation down to **0.02%** v/v alcohol possible
- **Product temperature < 39 °C**
- **With alcohol rectification** (for concentrating ethanol) to 80% v/v **or without rectification**
- Optional **with aroma recovery**

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Thank you … and see you soon !

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ASSOCIATED BEVERAGE SOLUTIONS

Presentation Erbslöh Seminar

By Juan Manuel Ropero & Onno Veenhoven

Let's bottle your growth!

Associated Beverage Solutions
Bottling & Services

Mission

With investments in technology and capacity we are the preferred partner and one-stop-solution for brand owners and producers in the beverage industry. We are pioneers in the no-low segment.

AB solutions is a contract beverage manufacturing company offering tailor made beverage processing and multi packing solutions on different production lines and with our highly skilled staff we aim to grow with our customers.

Our company is focused on excellent care for customers, staff and stakeholders.

History

- 2015: Takeover of JPS WS/Clos du Renard
- 2016: Startup of the bottling and warehousing operation
- 2017: Installation of brand new Bag in Box line
- 2017: Achievement of BRC and organic certification
- 2018: Opening of dealcoholization and fermentation (MIS)
- 2019: Installation of sparkling line with tunnel pastoriser
- 2022: Integration of MIS into AB-Solution by take over of De Bortoli Wines

Ownership

- Second largest family owned winery in Australia
- Founded in 1928 by Vittorio De Bortoli
- Innovators in the wine industry with long term focus

Activities

✓Tailor made fermentations starting from liquid base

✓Dealcoholizing of wine, beer, cider, fruit wine…..

✓Bottling of both still and sparkling product into glass and BIB

✓Storage and logistical solutions

Fermentation services

- ✓Tailor made fermentations
- ✓Basis of apple, rice, sugar……
- ✓Used for bulk shipment, bottling or dealcoholizing
- ✓Several filtration solutions

Dealcoholization

- ✓Vacuüm disitillation unit
- ✓3.000L p/h flow
- ✓API Schmidt-Bretten installed in 2018
- ✓Suited for 0.0% wines, beers, ciders
- ✓Clean and crisp beverages

Line 1: still wines in glass containers

- ✓From 18,7 till 150 cl
- ✓Over 50 shapes and formats
- ✓8.000 bottles per hour
- ✓Both cork and screwcap
- ✓Many labelling options included no-label-look, wrap around and embossed bottles
- ✓Full O2 management and control

Line 2: still and sparkling wines in glass containers

- ✓From 18,7 till 150 cl
- ✓Over 25 shapes and formats
- ✓Up to 8.000 bottles per hour
- ✓Both natural cork, crown cork and screwcap
- ✓Many labelling options included no-label-look, wrap around and embossed bottles
- ✓Full O2 management and control

Line 3: Bag in Box

- ✓New line (2017) from Smurfit Kappa
- ✓Suited for BIB and stand up pouch
- ✓Sizes: 1.5/2/2.25/3/5/10/20L
- ✓Full O2 management and control to ensure maximum shelf life

Logistics and warehousing

- ✓Capacity: 12.500 m2
- ✓Bonded and transit custom options
- ✓FIFO, scanning, SSCC to ensure full traceability
- ✓Full flexibility included case picking
- ✓Located in the heart of Europe nearby the ports of Antwerp, Rotterdam, Zeebrugge and Le Havre

R&D services

- ✓Growing demand for premium adult beverages
- ✓Higher price can only be defended by quality in the glass
- ✓How to create high end drinks?

Key Factors for a Beverage

- Equipment
- Base Product
- Additives

Developing the Perfect Receipt

Base Wine

Sauvignon Blanc, Muscatel/Muscat.

- Terpenes and Thiols are aromas resistant to heat
- Wine MUST be **protein** stable.

Additives

Grape Must Concentrate -> balance the mouth. Wine sensation.

Acid (tartaric, malic, lactic, citric) -> sugar compensation.

Mannoproteins / Arabic Gum -> body expression. Round mouth feeling. Color stabilization.

Tannins -> structure.

Aromas -> aroma expression and recover the wine feeling. Key to test **dosage**.

Oak -> length and highlight the wine categories.

Sensory Evaluation

Validation

Quality Control and Testing

Wine Quality Control Check

Wine analysis before and after processing.

Alcohol, Volatile Acidity, Total Acidity, Residual Sugar, SO2 upon reception.

Receipt Validation -> Sensory Control Check on every batch.

Ingredients List and Nutritional Values.

Bottling Control

Pasteurization

Dimethyl Dicarbonate, DMDC, E242

Microbiology

R&D services for the Market

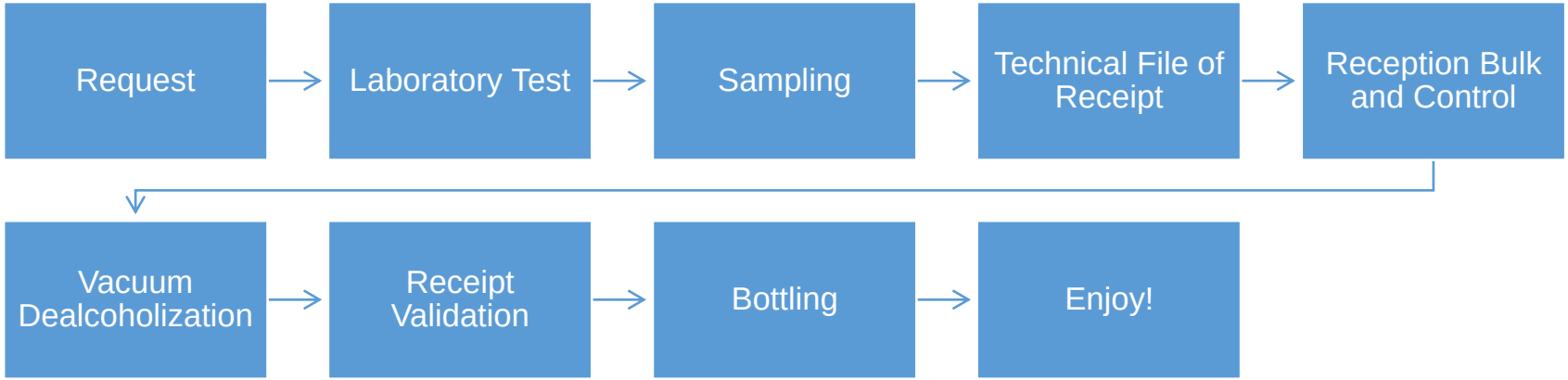
Rising Demand for Low – No/Lo Alcohol Beverages

Low alcohol market demand	Preference for Health-Conscious Options	New Generations

Products

Wine	Cider	Beer	Fruit Wines

R&D workflow


Request
Laboratory Test
Sampling
Technical File of Receipt
Reception Bulk and Control
Vacuum Dealcoholization
Receipt Validation
Bottling
Enjoy!

Why AB-Solutions?

- ✓Investing in capacity and technology
- ✓One-stop-shop solution
- ✓Product knowledge
- ✓No own brands = no competition
- ✓Multi packaging options
- ✓Located in the heart of Europe

We are your scale-up-partner!

Let's bottle your growth!

Associated Beverage Solutions
Bottling & Services

Let's bottle your growth!

Associated Beverage Solutions
Bottling & Services

Zero Alcohol Wines

Fruit Wine Tasting

Maximilian Schmelzer
Erbslöh Geisenheim GmbH

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Zero Alcohol Wine – Fruit Wine Tasting

Reasons für „no alcohol“ beverages

Reasons for a alcohol free cider/ fruit wine/beer/cocktails

- Local rules -> car driving, work safety
- Lower calory index
- Body awareness (Sober January, Dry January)
- Negative reactions with alcohol
- Age -> legal drinking
- Pregnancy
- Religion

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Zero Alcohol Wine – Fruit Wine Tasting

Definitions

What definition do we know:

Wine:

- Product description (label): dealcolised, additonal alcohol free is possible. If the alcohol content is >0,05 ABV % -> additional „alcohol content <0,5 vol. %

Beer/Cider/Fruit wine/Cocktails etc.

- German law: alcohol free with < 0,5 ABV %

Fruit Juice:

- Local differences ->Germany max. 3 g/L Alcohol -> 0,38 ABV %.

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Zero Alcohol Wine – Fruit Wine Tasting

Thermal Dealcoholisation – Example Riesling

- Alcohol: 0,267 % ABV
- Sugar: 17,2 g/L
- Acidity [TA]: 8,0 g/L

Riesling is a Terpen driven variety.

Terpens are glucosidic-bound in wine.

Release via yeast enzyme or added enzyme (beta-glucosidase).

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Zero Alcohol Wine – Fruit Wine Tasting

Thermal Dealcoholisation – Example Pinot Blanc

Natural aromatisation with wood

- Alcohol: 0,2 % ABV
- Sugar: 18,1 g/L
- Acidity [TA]: 6,9 g/L

Storage of the dealcoholuezed product in wooden barrel.

Partly in used and new barrels (toasing flavour).

Very „winy“ character

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Zero Alcohol Wine – Fruit Wine Tasting

Thermal Dealcoholisation – Example Gewürztraminer

Natural aromatisation varietal aroma and sweetness

- Alcohol: 0,27 % ABV
- Sugar: 58,5 g/L
- Acidity [TA]: 6,1 g/L

Terpen driven aroma.

Possible add back of a Gewürtraminer juice to achieve a varietal wine style.

Beta-Glucosidase in terpen juice release more varietal aroma.

WEINGUTS-WEINE
LINIE
BREAKAWAY

GEWÜRZTRAMINER
ENTALKOHOLISIERT

KATEGORIE BREAKAWAY **REBSORTE** GEWÜRZTRAMINER **AUSBAU** STAHLTANK
ALKOHOL 0,27 % VOL. **RESTZUCKER** 58,5 G/L **GESAMTSÄURE** 6,1 G/L

DATUM DER ABFÜLLUNG 16.03.2023

SENSORIK ÄUSSERLICH VON EINEM WEIN NICHT ZU UNTERSCHEIDEN MIT ELEGANTEM SCHWARZSILBERNEN ETIKETT UND STROHGELBER FARBE; DUFTET NACH GETROCKNETEN ROSENBLÜTEN UND ETWAS WASSERMELONE; IM MUND SAFTIG UND AROMENREICH (APFEL, TEE ...) MIT ANGENEHM GERUNDETER SÄURE, SCHMECKT FRISCH, APFELIGER ABGANG, DAS IST GUT GEMACHT UND SCHMECKT AN JEDEM HEISSEN SOMMERTAG; DEN ALKOHOL VERMISST MAN NICHT!

TRINKTEMPERATUR 10°-12° C **ARTIKEL-NR.** E30 **EAN** 4260613395207 **FLASCHENGRÖSSE** 0,75 LITER
ENTHÄLT SULFITE UND STAMMT AUS DEUTSCHLAND.
DIESES PRODUKT KANN GANZ ODER TEILWEISE AUS WEIN/TRAUBEN BEFREUNDETER WINZER ERZEUGT SEIN.

BERGDOLT-REIF & NETT GMBH
DUDOSTRASSE 2 | D-67435 DUTTWEILER/PFALZ
TEL.: (0 63 27) 28 03

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Zero Alcohol Wine – Fruit Wine Tasting

Thermal Dealcoholisation – Example Cider

Origin and time as a strategy

- 80 % Hochstamm apples
- Only apples from Thurgau
- Cloudy cider

Storage over 3 month in wooden barrels

Each barrel with 21.000 L capacity

Barrels made with local oak from Thurgau

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Zero Alcohol Wine – Fruit Wine Tasting

What can we learn from brewers?

Alcohol free strategies in brewing:

- Dealcoholsation
- Biotechnological methods
  - Fast stop of fermentation
  - Non fermenting yeasts (Yeast strains with limited alcohol production)
  - Malolactic fermentation and limited yeast use

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Zero Alcohol Wine – Fruit Wine Tasting

Alcohol avoiding strategy – create a wine taste without wine

Manufactur Jörg Geiger No. 23

- German Wild Apples „Streuobst“ -> Bitter and sour taste -> The German Cider version
- Rhubarb juice
- Apple blossom extract

- Designed as stand allone bevergae
- Higher price category

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Zero Alcohol Wine – Fruit Wine Tasting

Alcohol is the major taste transporter!

- Dealcoholised products have often a lack of taste and aroma
- The easiest way of compensation is sugar

Which sugar alternatives are available?

Do your own tests!

- Oenological tannis, Gum arabic/Mannoproteins
- 2 different dealcoholised products (wine and German apple wine)

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Zero Alcohol Wine – Fruit Wine Tasting

Test session

- Tannivin® Intense: 0,1 – 0,5 ml/100 mL -> 1 – 5 g/100L
- Tannivin® Premium: 0,1 – 1 ml/100 mL -> 1 – 10 g/100L
- Tannivin® Finesse: 0,1 – 2 ml/100 mL -> 1 – 20 g/100L

- MixGum: 0,2 – 0,4 mL/100 mL -> 100 – 500 mL/100L
- SenSo Ü: 0,1 – 0,3 mL/100 mL -> 100 – 300 mL/100L

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Zero Alcohol Wine – Fruit Wine Tasting

Body, fruit and colour – everthing is possible

A non-alcoholic wine with an intense red color made from blackcurrants grown in Lithuania. This wine has managed to keep the strong aroma of these ripe berries and their long-lasting flavor.

Taste and aroma

Intensive ripe berry taste, full and rich aroma.

Recommended serving

This wine pairs with red meat dishes, braised game, cured wild boar ham and sausage, long-ripened cheeses.

Recommended serving temperature: 14-16 °C.

Thank you very much for our joint walk through the world of non-alcoholic wines

Maximilian Schmelzer
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Head of Wine Germany/Benelux/Switzerland

Enzyme application in CEO production

Peter Dietrich
Head of Fruit Processing

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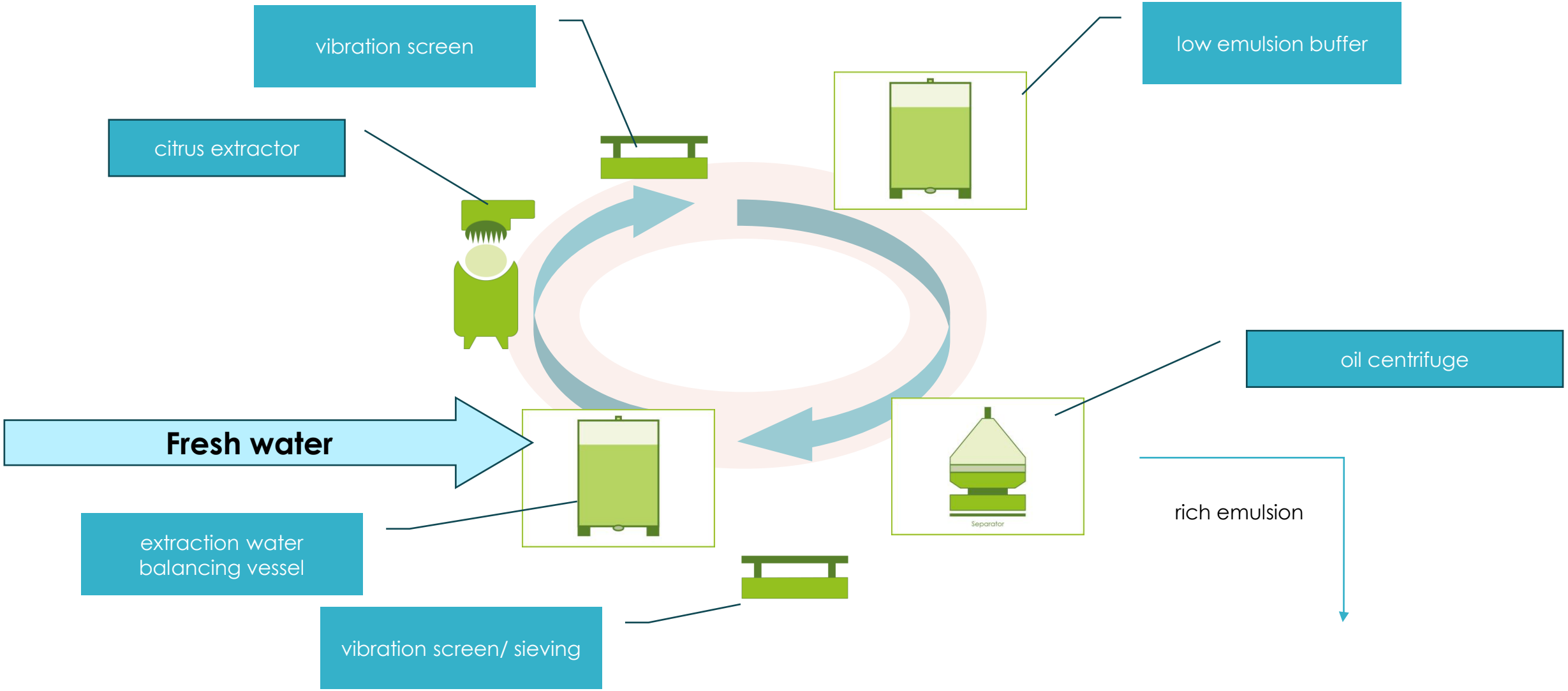
Extraction water loop in ESO processing



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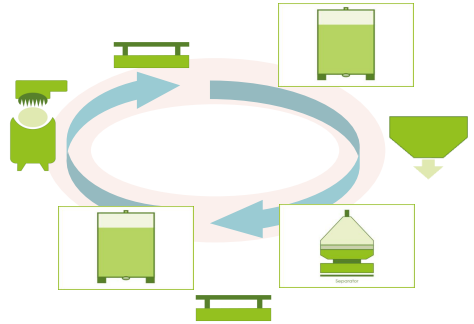
Efficiency of low-emulsion treatment

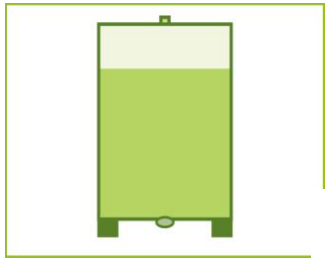
relation of pulp reduction to oil yield



Extraction water +pulp+oil+sand

WASTE
Oil&Wax (v/v) < 0.2%

Low emulsion



Oil&Wax (v/v) 0.8-1.5 %
Solids < 5%

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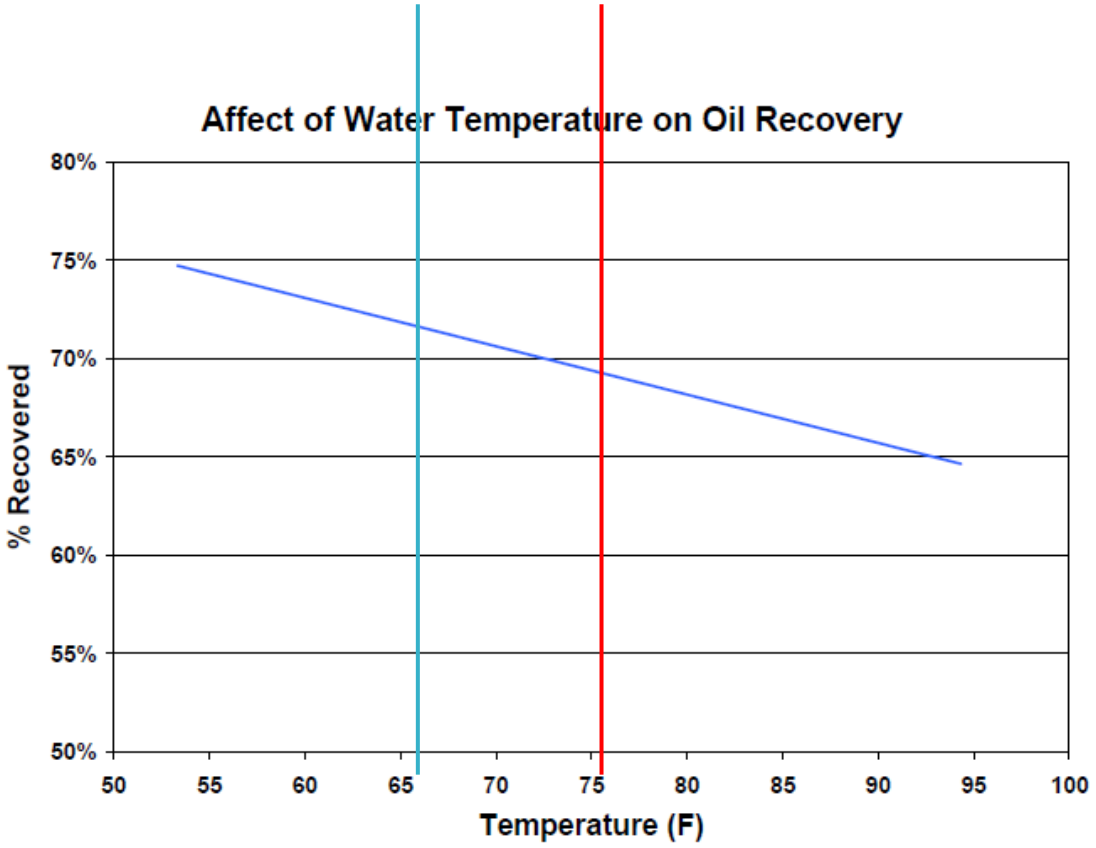
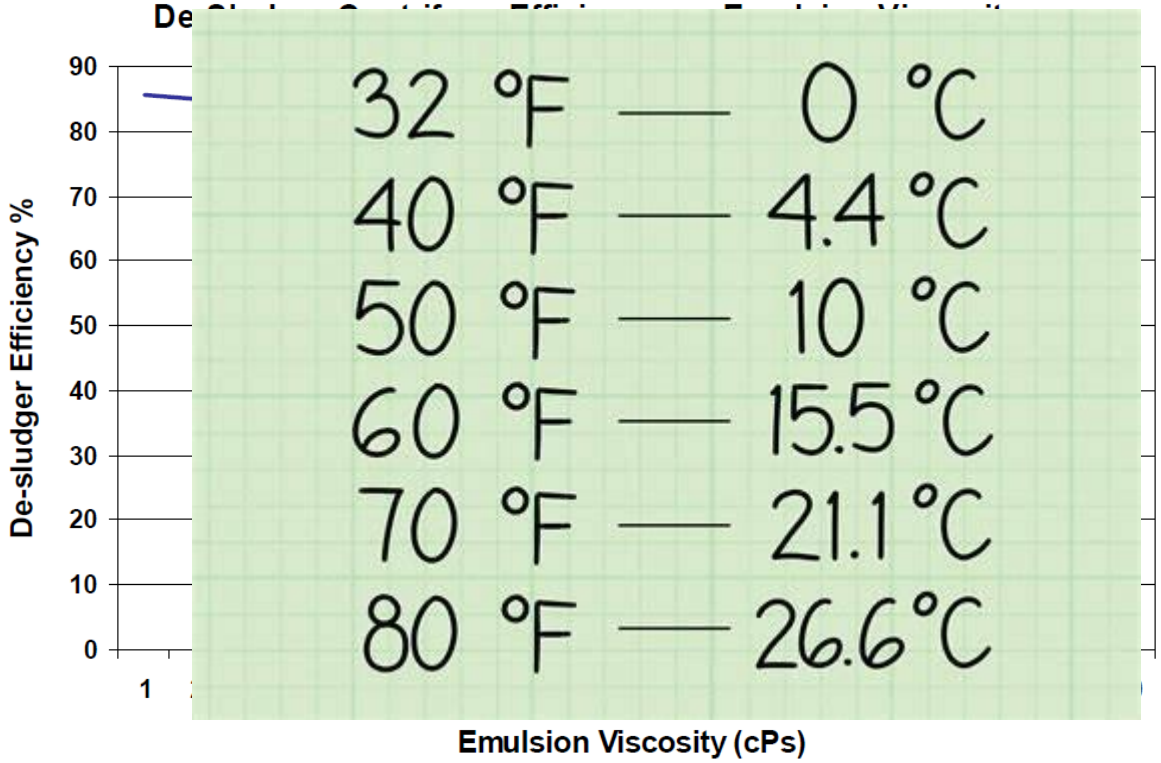
How does enzyme action work here?





Quelle: JBT ESO Manual

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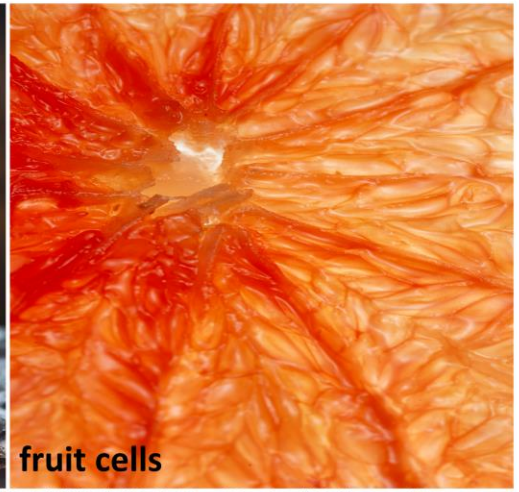
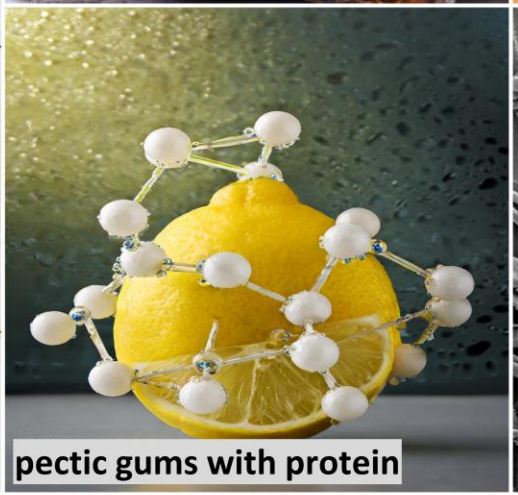
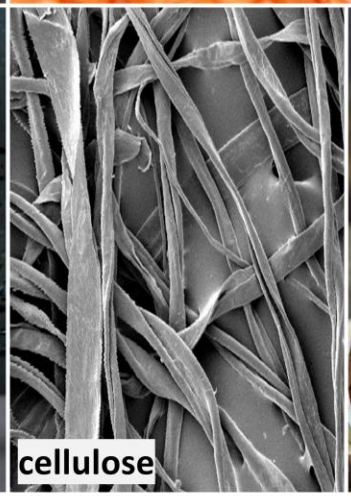
Composition of de-oiling sludge

Troublesome viscosity builders based on pectins







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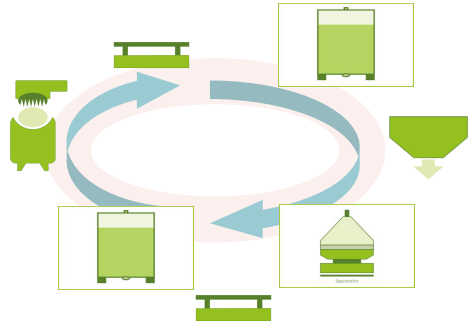
High operational yield of centrifuges

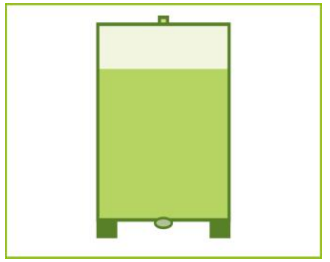
Impact on oil content of centrifuge fractions

- Reduce oil losses
- Oil content in centrifuge sludge
  << 5%
- „complete“ break down of oil and water complexes
- Less oil in water loop
- Oil content in rich emulsion
- Shortening of winterisation



Low emulsion
0.8-1.5 % oil

Centrifuge 1



FRIT = WASTE
Sludge with lowest oil content

Rich emulsion **with min. 85% oil**

Water addition

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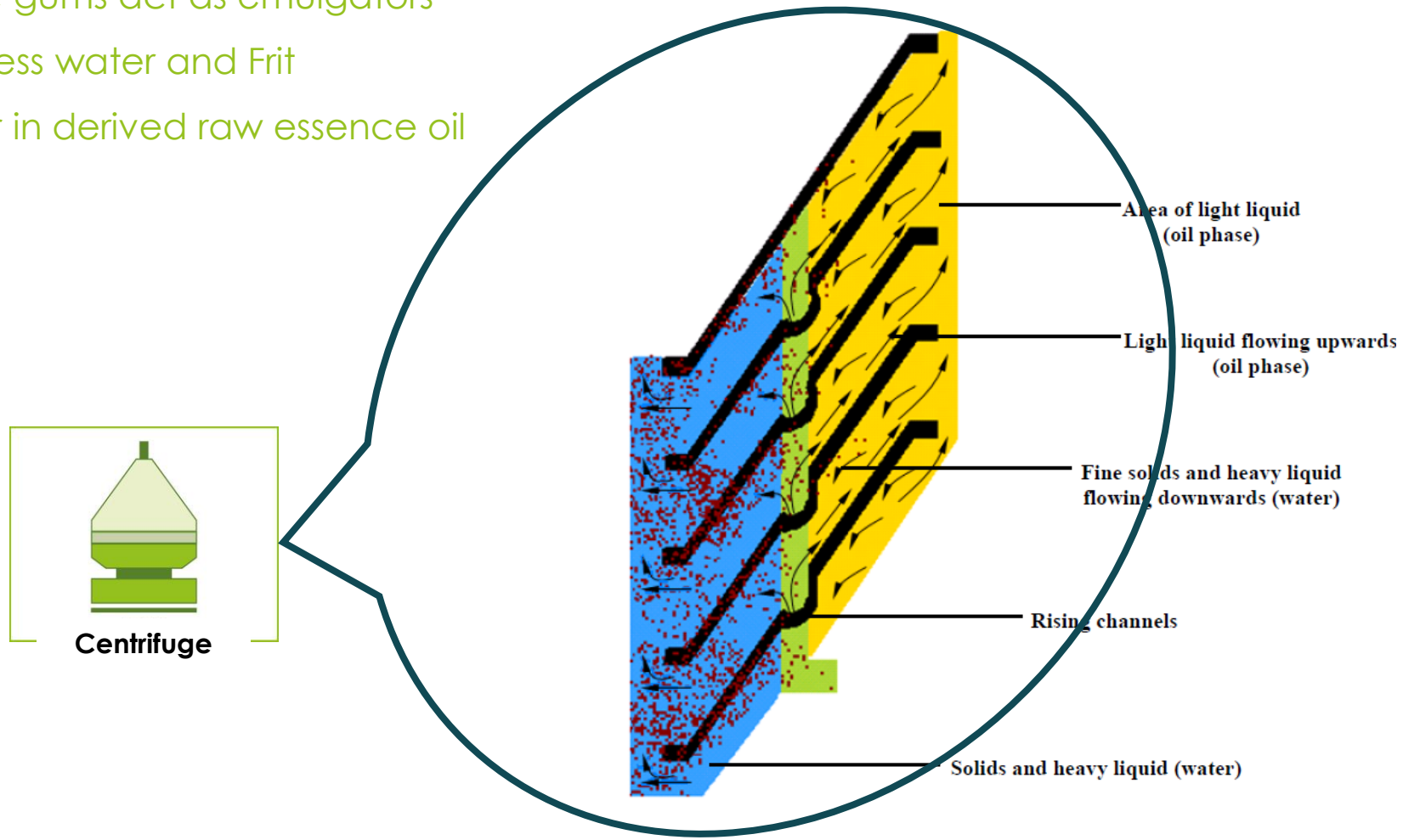
Breaking the emulsion

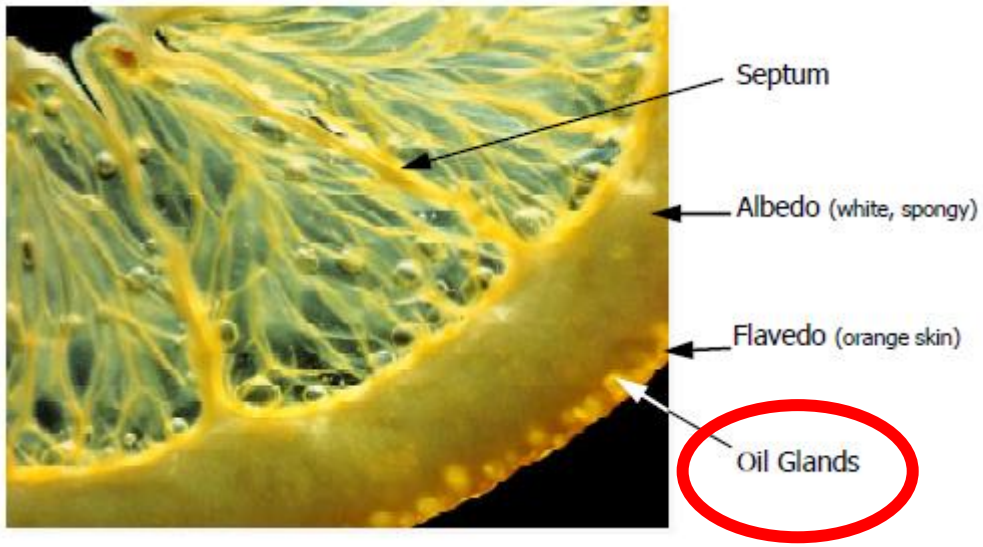
- Protein+pectic gums act as emulgators
- Lost oil in process water and Frit
- Residual water in derived raw essence oil

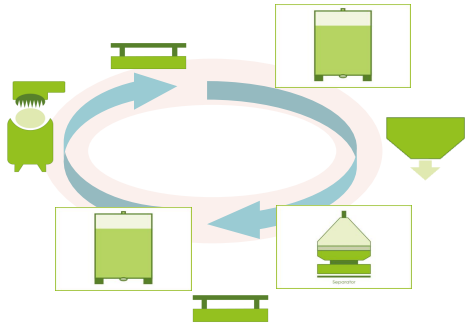


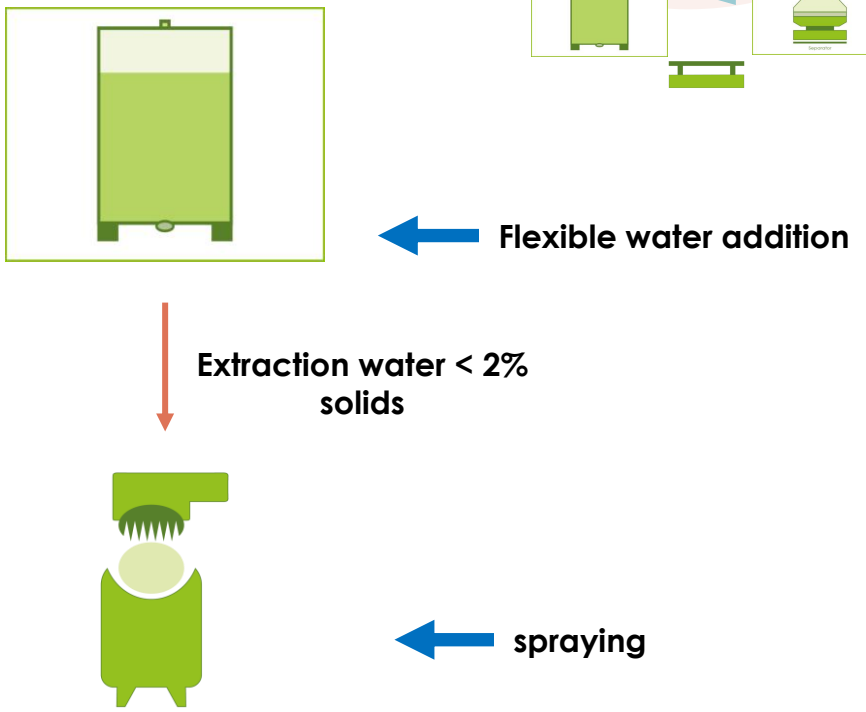
Efficacy of initial oil extraction

displacement ***≠ solution***

Spray nozzles → alignment, tightness, water quality







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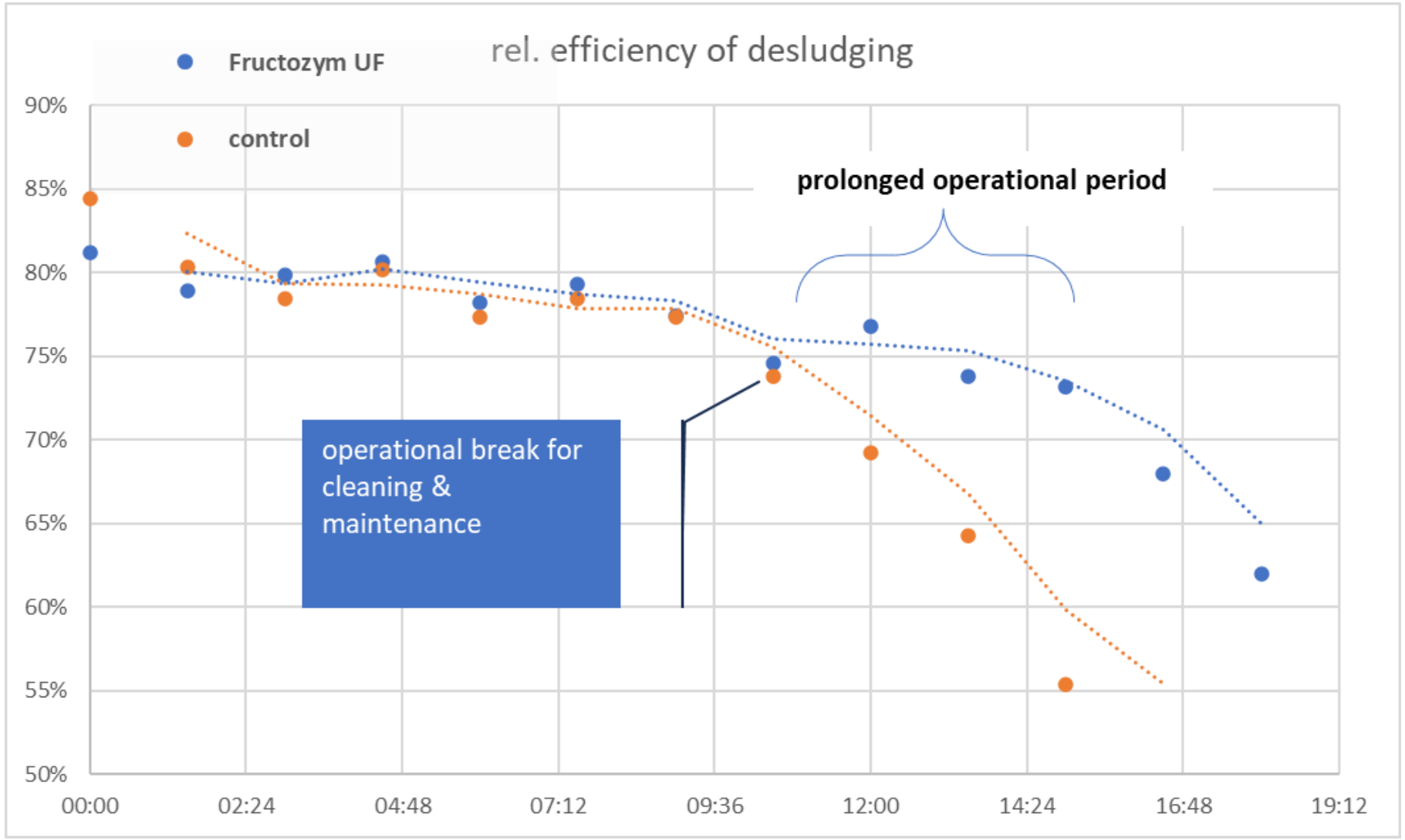
Prolonged operational time



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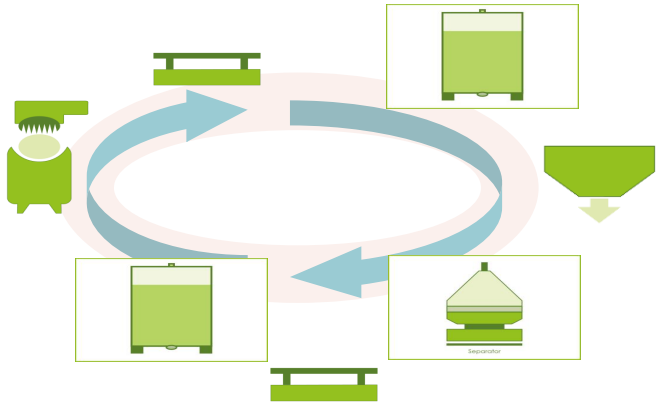
Traits for an ESO production enzyme

Final yield of essence oil = (yielded oil × operational period) ***minus*** unavoidable losses

- High performance pectinase with reduced methylesterase → viscosity reduction
- Blend of arabanase & rhamno-galacturonase I → improved pulp separation
- Acid protease → break of protein-pectin complexes



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Fructozym UF opens new horizons

Classic blend of galacturonase-arabanase-acid protease

- Significant increase of operational yield
- Prolonged operational period of set-up
- 30 % reduced water consumption
- Shortened winterisation time
- No negative impact on quality parameters
- Non-GMO
- Halal & kosher
- Registered at EFSA

Many thanks for your attention!

Contact me:
peter.dietrich@erbsloeh.com

Citrus Juice Extraction – Essentials for Yield and Quality

BUCHER unipektin

Dr. Edgar Zimmer
Head of Technology and Development

Public

The Citrus Juice Extraction Process

Fruit

Juice Extraction

Others

40-50 %

Juice

50-60 %

By-products' recovery

- Essential oil
- Pulp wash
- Pulp recovery
- Core wash
- Peel extract
- Pellets
- "Pectin" peel
- Fibers
- ….

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Challenge: Fruit Quality

Juice Extraction

Fruit

Juice

...

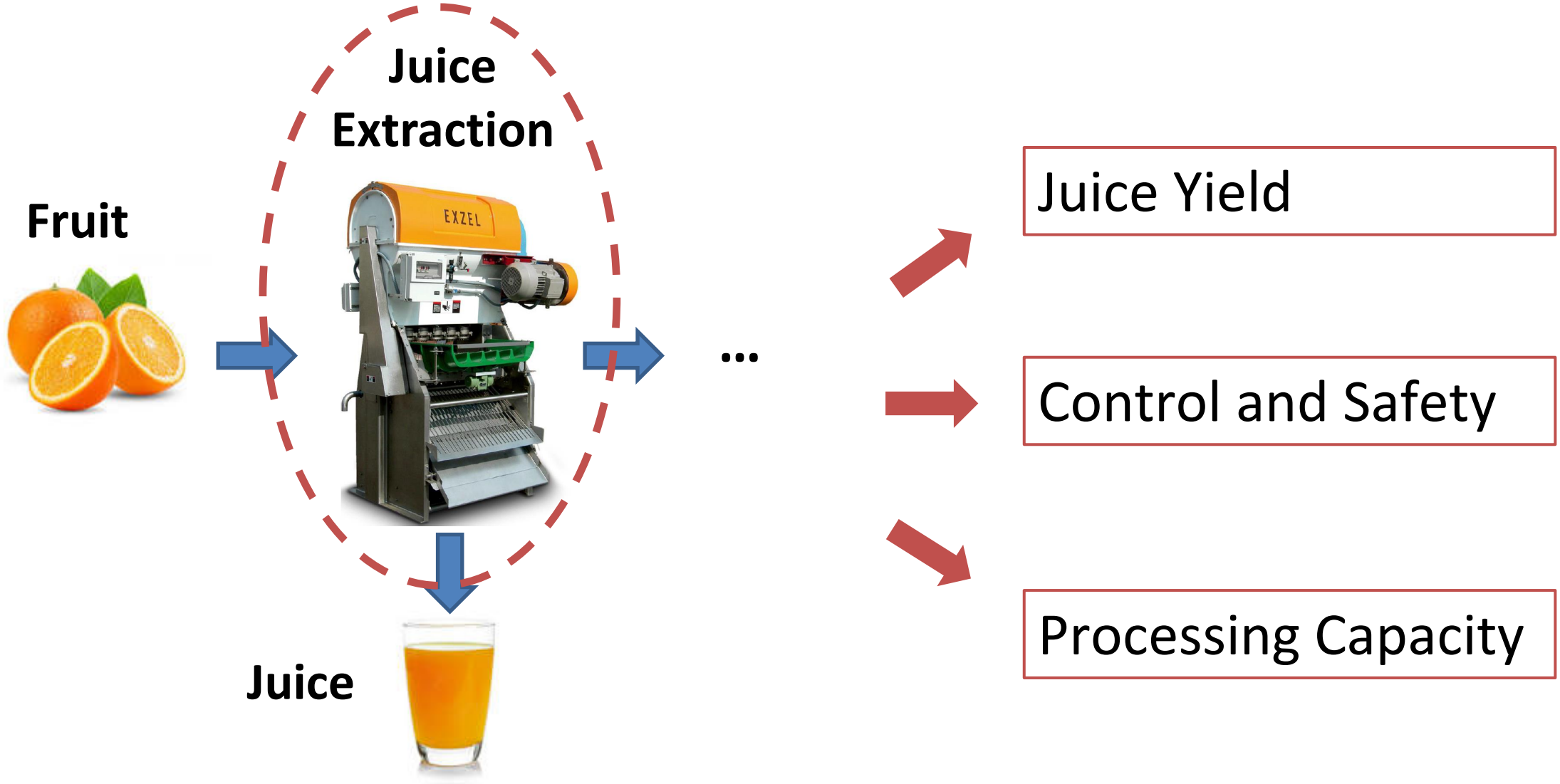
Juice Yield
(test results, in kg/kg)

Bad fruit → 35,77% (B.F.)

Good fruit → 68,69% (B.F.)
60,68% (A.F.)

DIFFERENCE: >30% abs.

Extraction: Essentials



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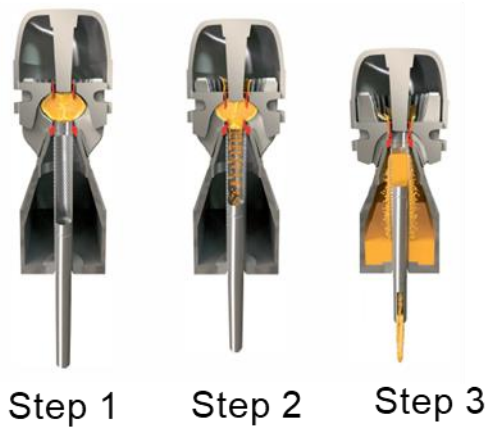
Extraction: How does it work ?

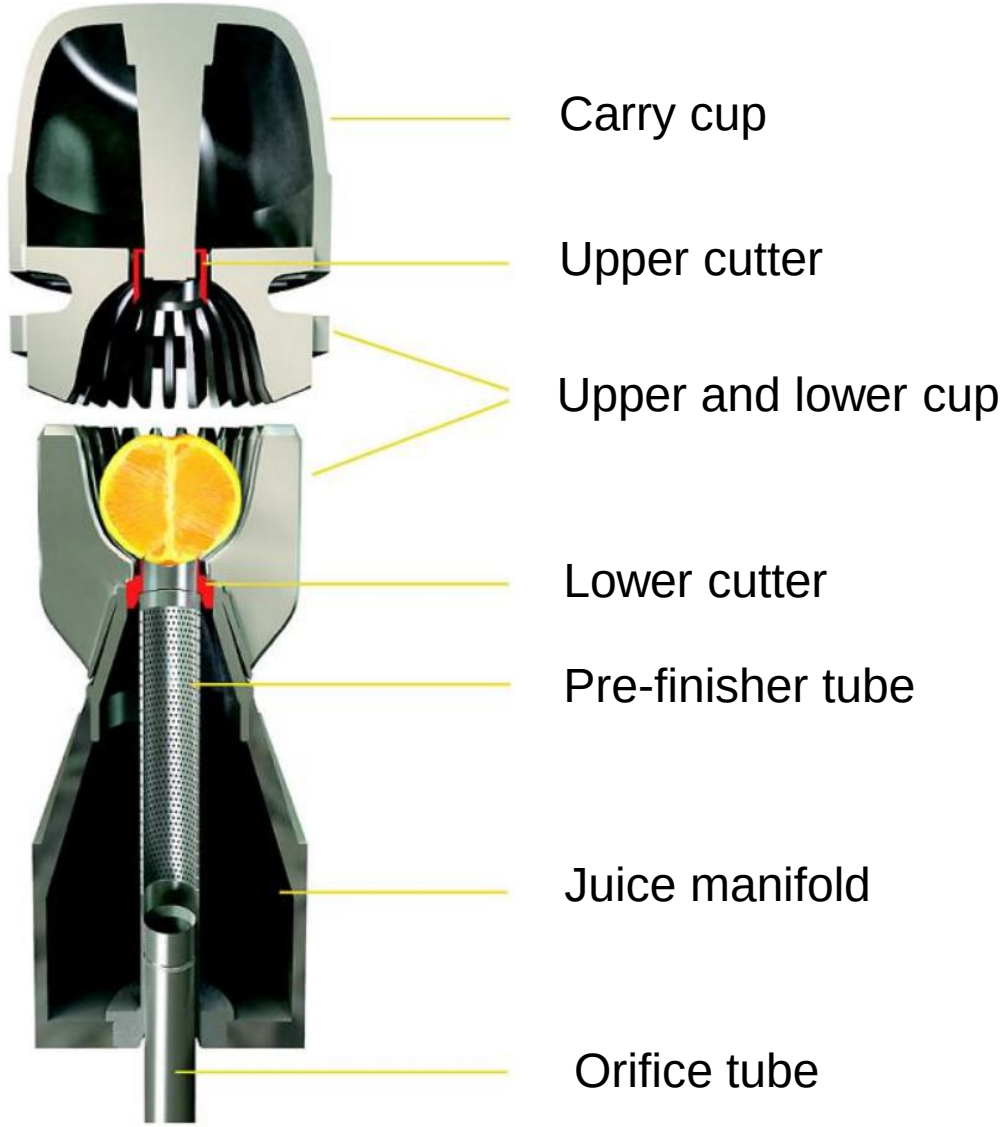
Extraction Process



Step 1: The interlocking upper and lower cups press the fruit against the upper and lower cutters, which make precise circular cuts on both sides. This prevents the intrusion of essential oils during squeezing.

Step 2: The content of the inner part of the fruit (pulp and juice) passes through the lower cutter and into the strainer tube. The peel is expelled through the upper cup and the oil is washed away by a spray system and transported as an emulsion for subsequent recovery.

Step 3: The orifice tube moves up inside the strainer tube, and the juice reaches the juice box after being pulp-filtered by the strainer tube orifices. Remaining seeds, membranes and fibres are expelled through the inside of the orifice tube.



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Extraction: How does it work ?

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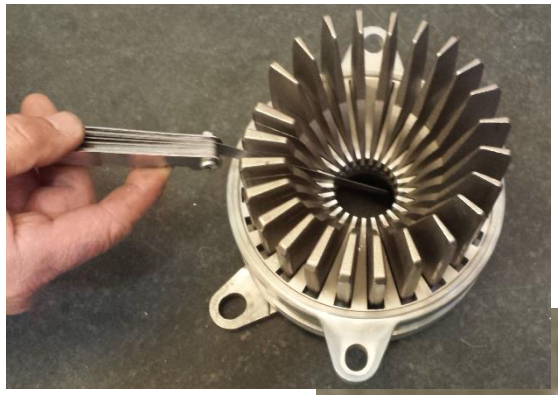
Extraction: Juice Yield

Juice Yield

Control and Safety

Processing Capacity



Clearance between cups

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Extraction: Juice Yield

Juice Yield

Control and Safety

Processing Capacity

Usual manufacturing by casting (foundry)

Manufacturing by EDM (Electrical Discharge Machining):

highest precision

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Extraction: Juice Yield

Juice Yield

Control and Safety

Processing Capacity

Clearance between cups

Casting → **0.5-0.6 mm**

EDM → **0.3-0.4 mm**

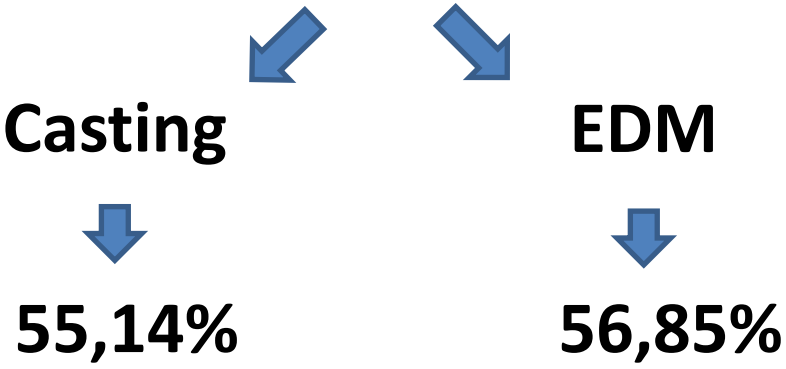
Extraction: Juice Yield

Juice Yield

Control and Safety

Processing Capacity

Juice Yield (test results, in kg/kg)
Orange, variety: Valencia
3” STANDARD COMPONENTS



IMPROVEMENT: 1.7% abs.

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Extraction: Capacity

Juice Yield

Control and Safety

Processing Capacity

Criteria: Minimize the number of stops and the time to solve the problems

Alarms for:

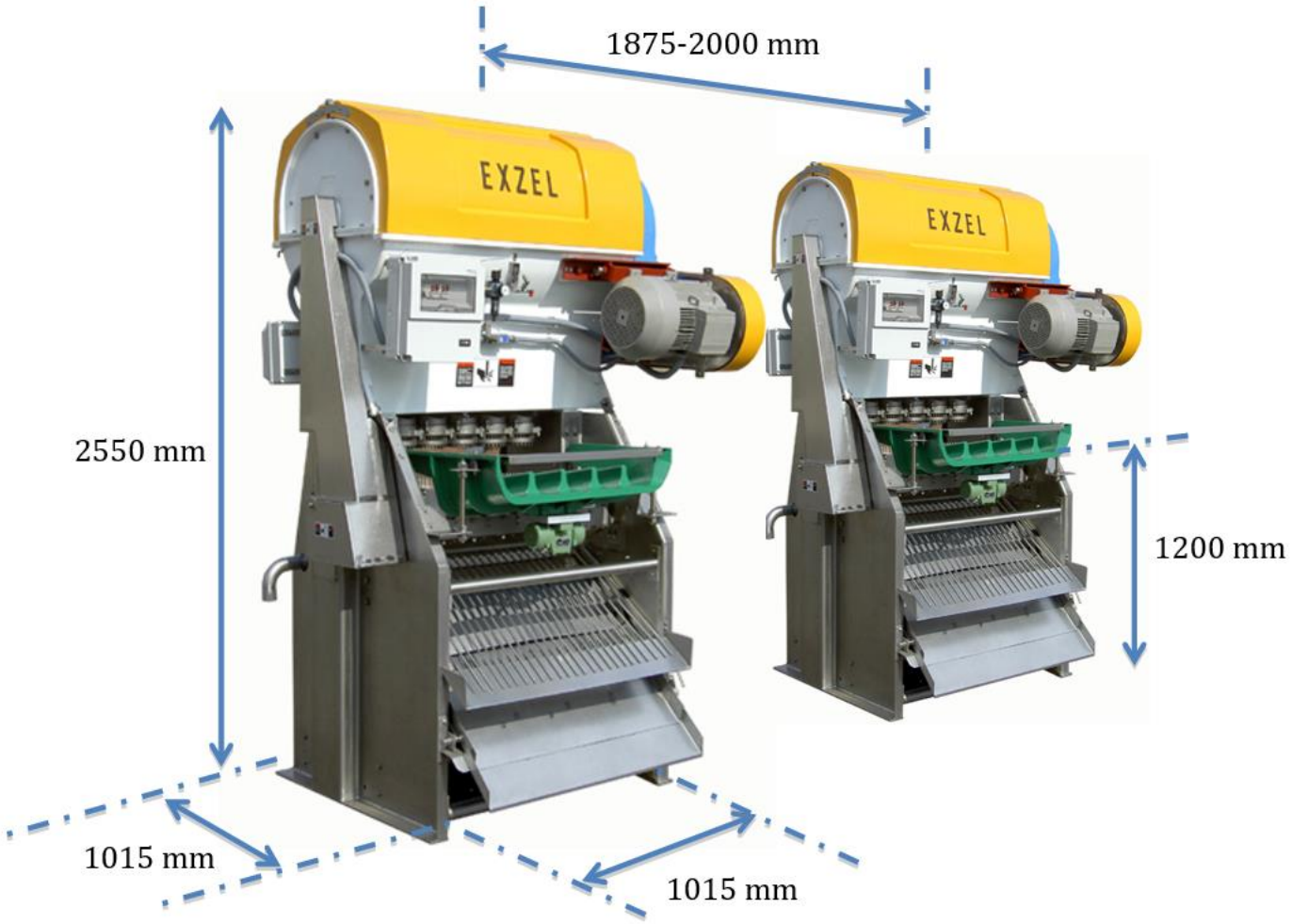
- **circuit breaker**
- **lubrication**
- **compressed air**
- **rear door**
- **juice box position**
- **hand-wheel door**
- **upper cup's shaft position**

Extraction: Capacity

Juice Yield

Control and Safety

Processing Capacity



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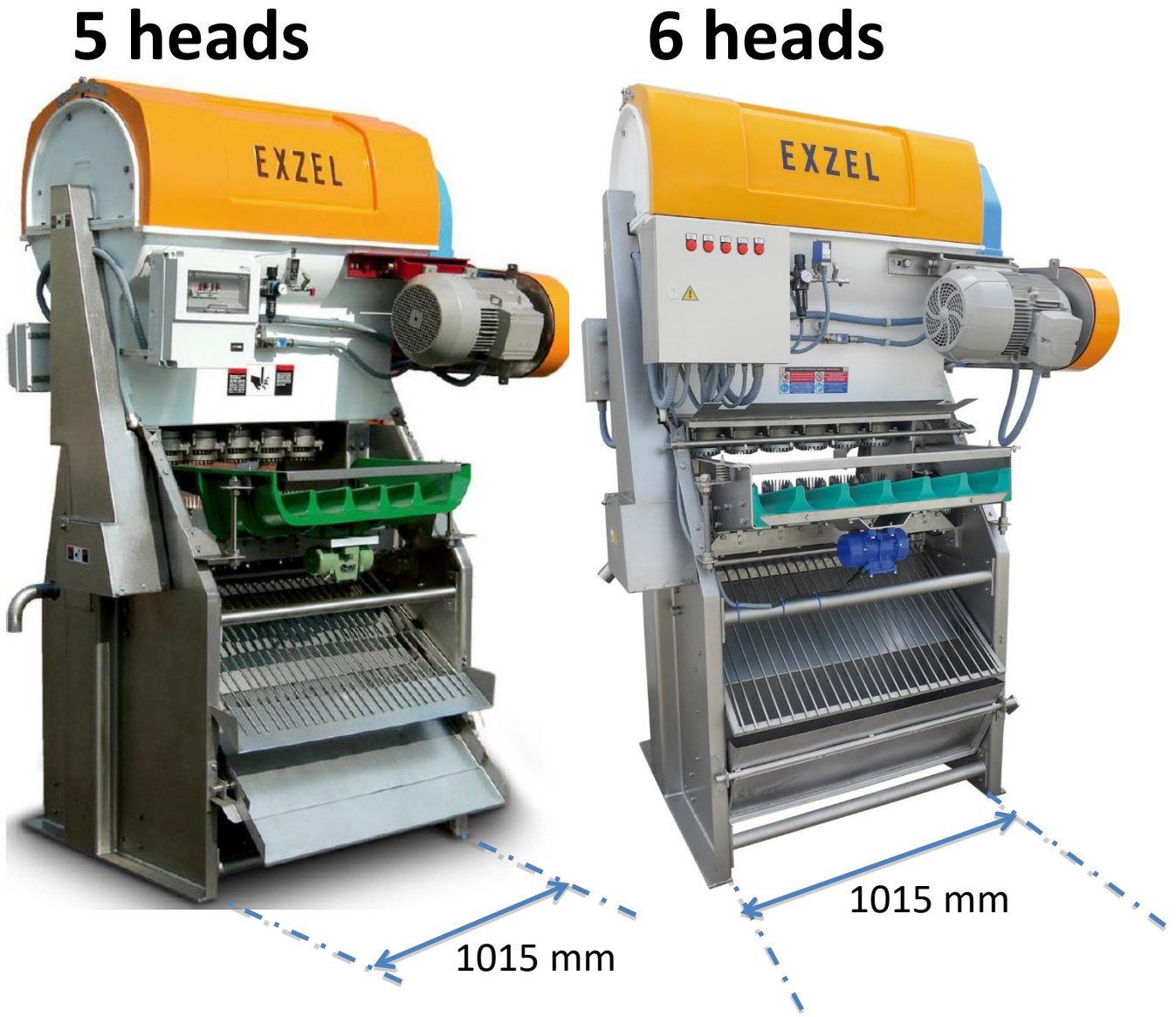
Extraction: Capacity

Juice Yield

Control and Safety

Processing Capacity



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Extraction: Capacity

Juice Yield

Control and Safety

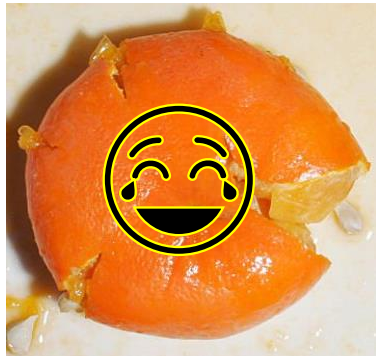
Processing Capacity

6 heads extractor:

- **Increase of processing capacity: 20%**
- **Same footprint (no need for additional adjustments)**

Citrus Juice Extraction Essentials - Summary

- Highest juice yield requires highest precision of extractor cups
- More heads per extractor provide more capacity with the same foot print
- Reliability of the extractors key for line efficiency
- Overall, impact of fruit quality can not be reversed by technology



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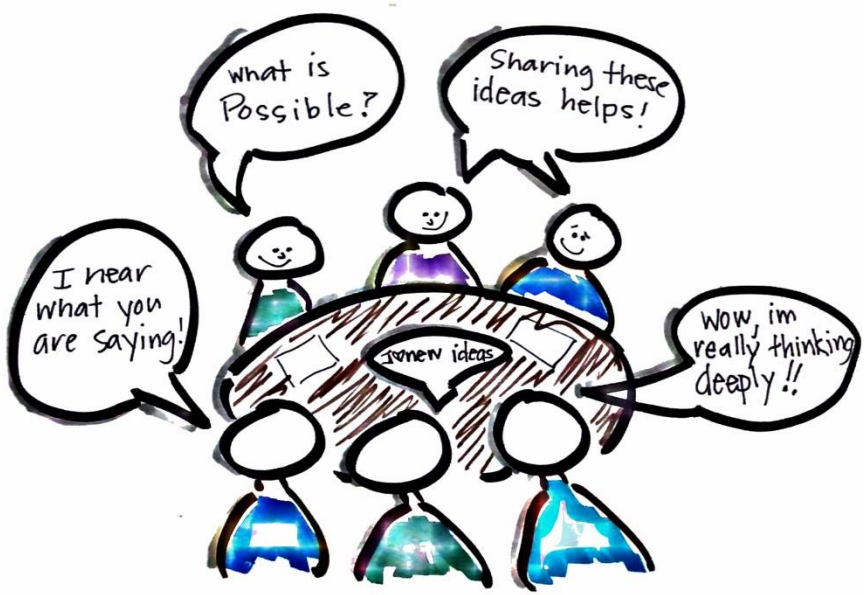
Thank you !



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Resin Technologies for Upgrading Juices and Extracts

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Dr. Edgar Zimmer
Head of Technology and Development

Public

Resin Applications in Fruit Processing

Many juices and by-products require refining for consumer acceptance:

Stability	- Post hazing (clarified products)
Colour	- Dark, brownish (clarified products)
Bitterness	- Limonin - Impact of HLB greening - Naringin (grapefruit)
High Acidity	- Increasing sugar/acid ratio
Astringency	- Polyphenols (peel extracts)

Removing these defects creates value !

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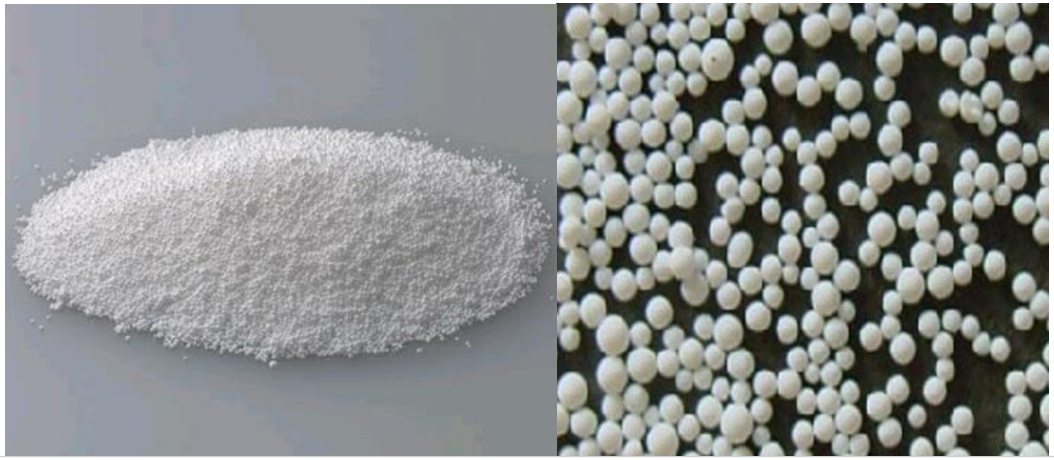
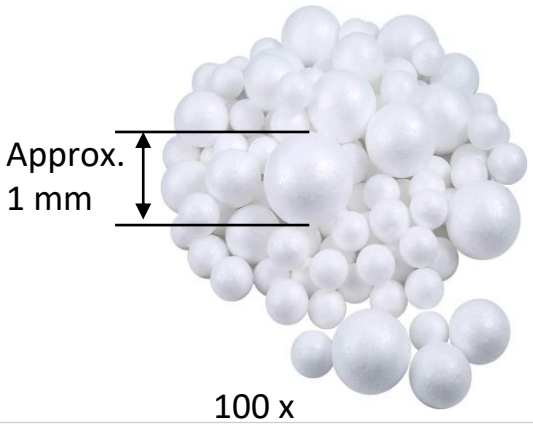
Resin Technology

… a versatile tool for removing undesirable components

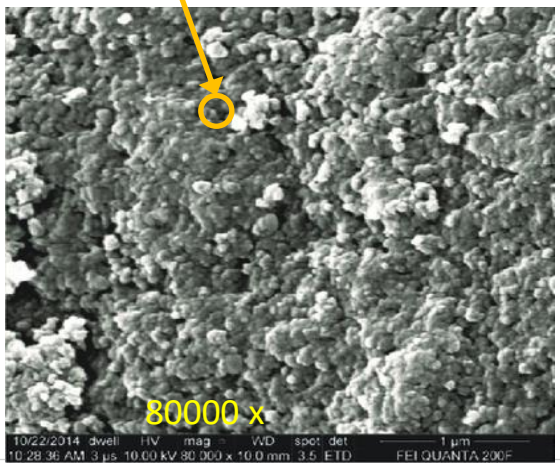
What is a resin ?

- Polymer beads (polyester, polystyrene, …)
- Single beads with diameter 0.3 – 1.0 mm
- Highly porous 3-dimensional structures: e.g. 400 – 600 m2/g
- Pore size depending on application
- “Inert” (adsorbent) or “functionalized” (ion exchange)





Average pore:
e.g. 0.24 µm = 240 nm



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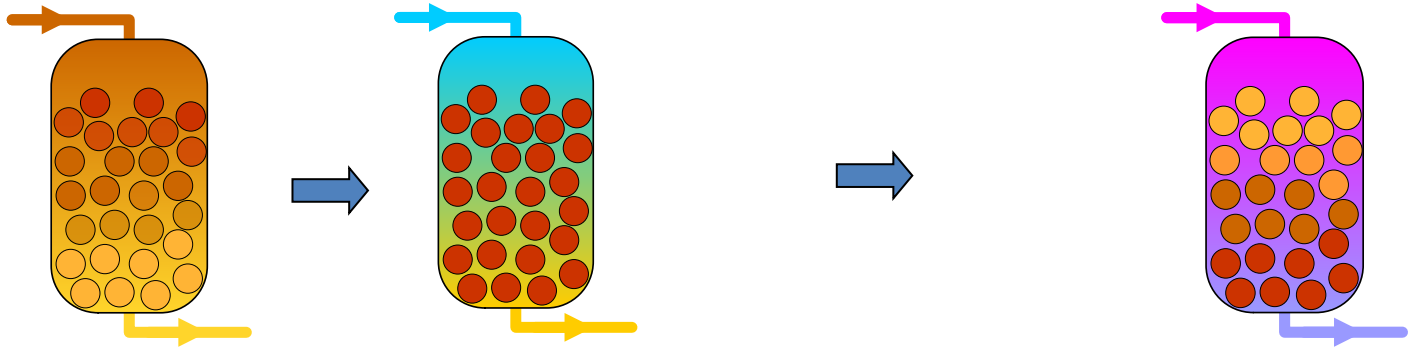
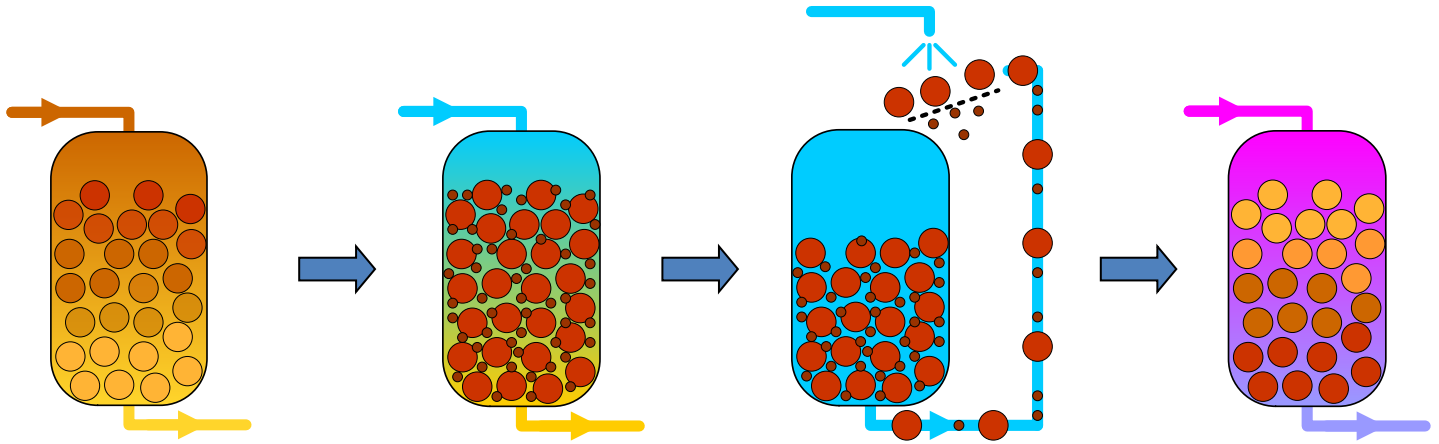
Resin Technology – **How does it work ?**

Clear juice



Production **Displacement** **Resin Wash** **Regeneration**

Cloudy juice (pulp reduced)



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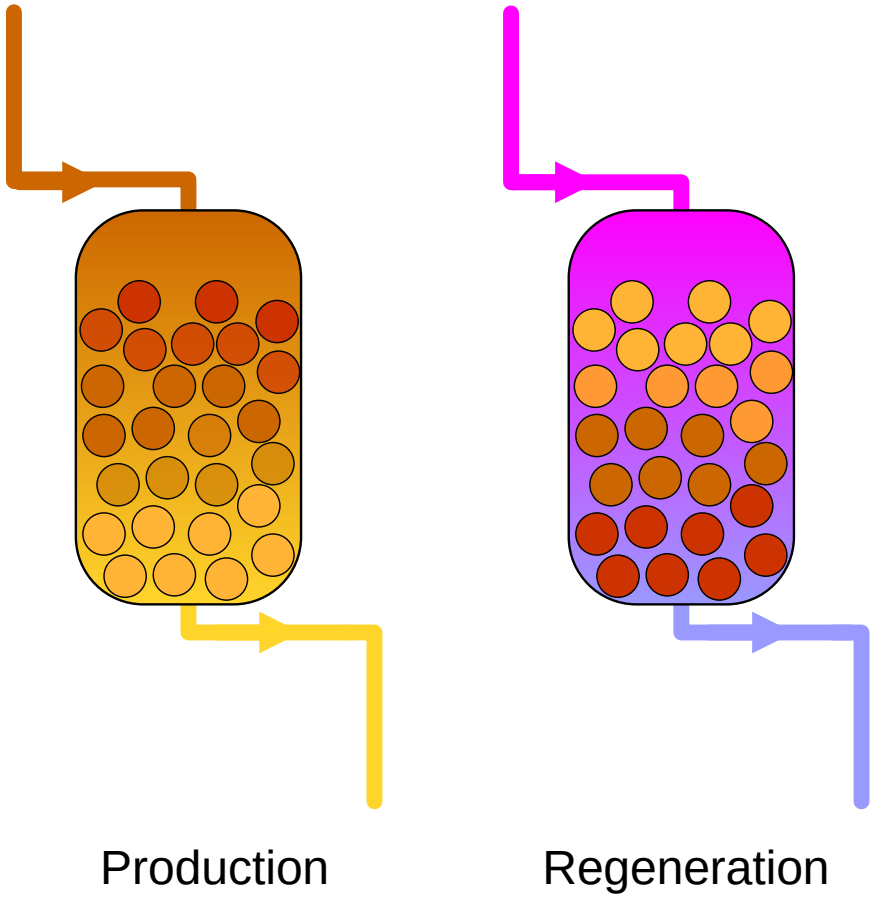
Resin Technology – **How does it work ?**

2-Vessel System



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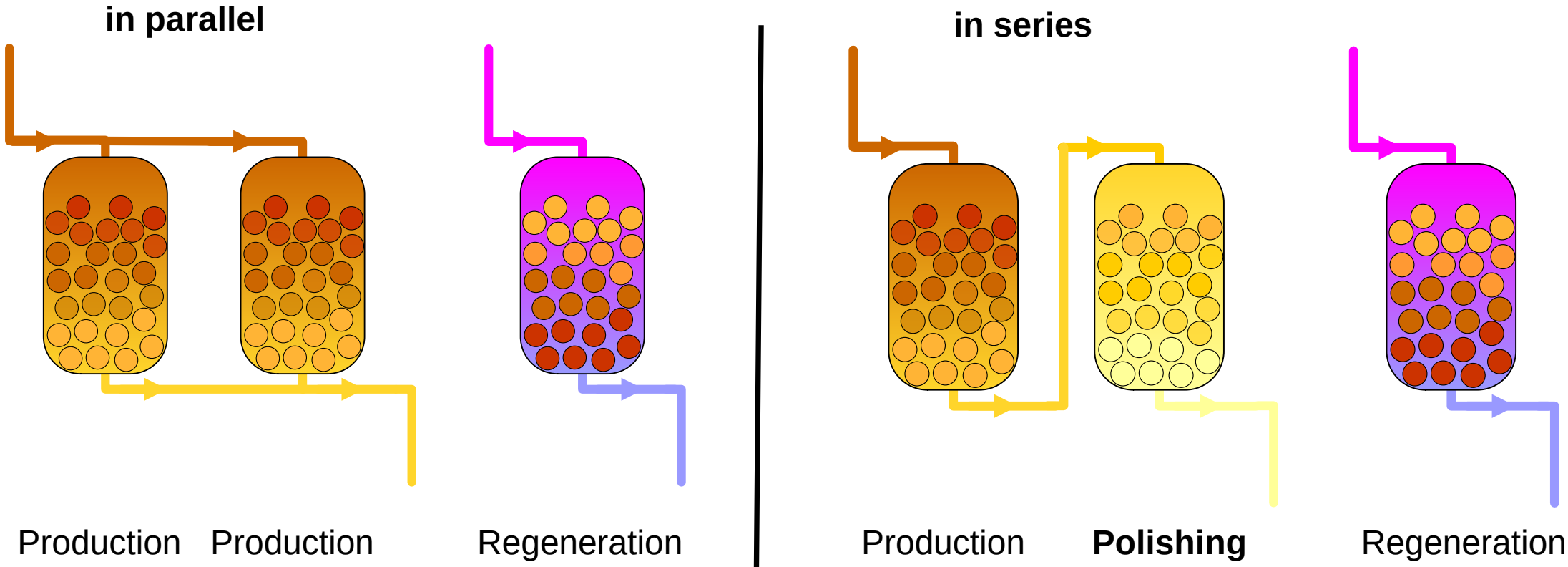
Resin Technology – **How does it work ?**

3-Vessel System



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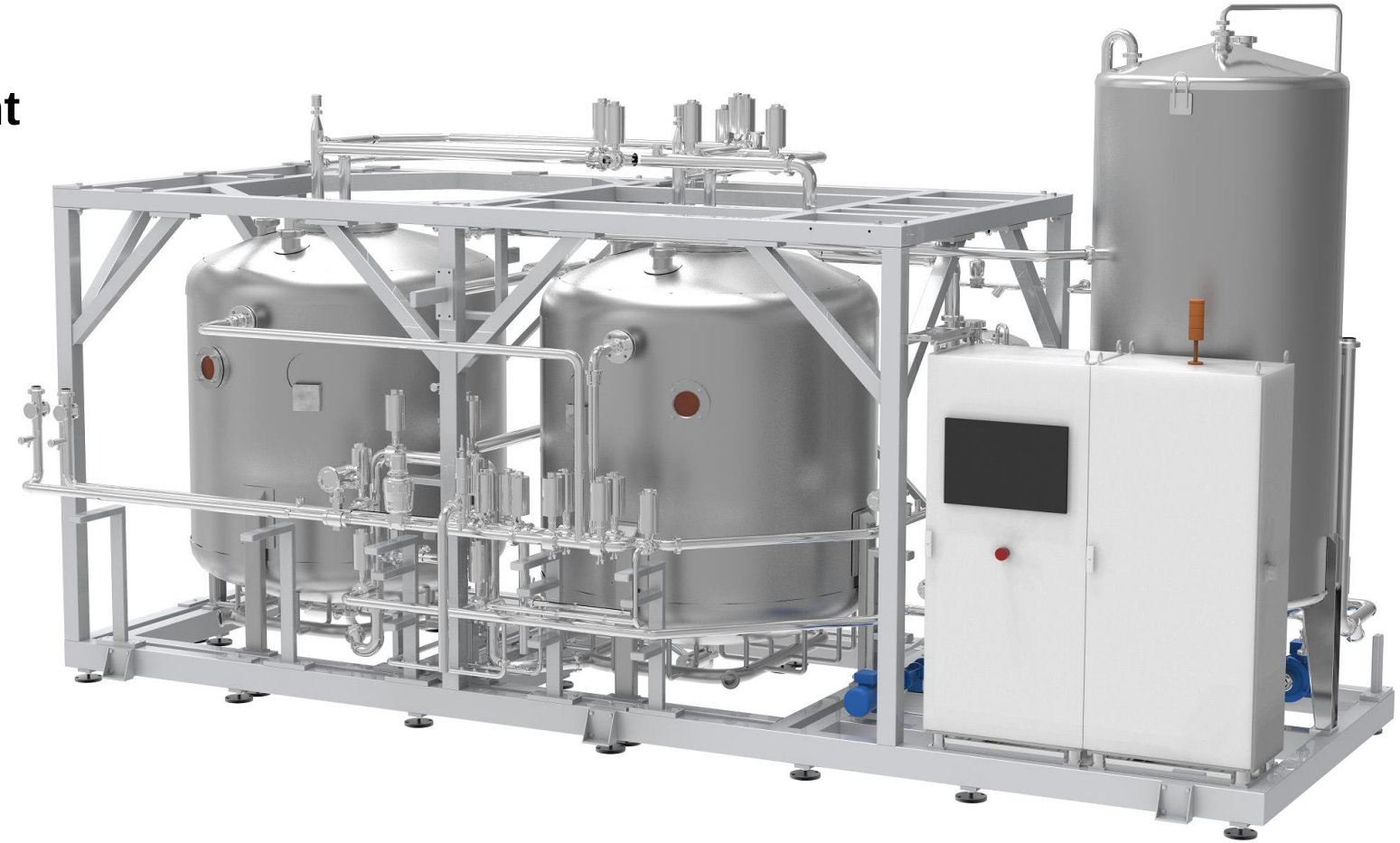
Resin Plant Design – Clarified Products

2-Vessel stabilisation plant for <u>clear</u> apple juice



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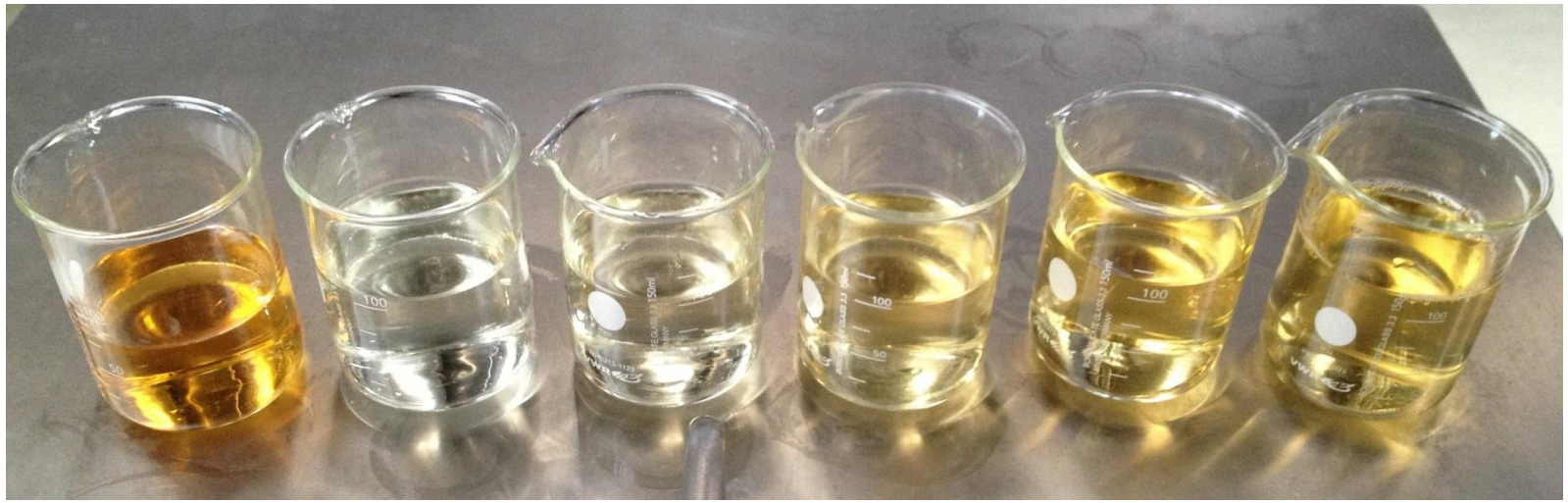
Apple Juice Stabilisation / De-Colourisation

		Feed product after paper sheet filtration					
Acid	Brix	420nm	NTU	NTU n. WT	Pina	Gushing	No.
19 g/l	20	0.70	0.8	4.4	144	! 66/75/82 g .!	0*

Volumes		P495		I				FPX66		II			
m^3	bv	420nm	NTU	NTU n. WT	Pina	Gushing	No.	420nm	NTU	NTU n. WT	Pina	Gushing	No.
50	21	0.33	0.3	0.6	1’	2/3/3 o x	I 1*	0.12	0.3	0.6	1’	4/2/3 o !	II 1*
100	42	0.44	0.3	0.6	1’	2/2/1 o x	I 2*	0.25	0.3	0.7	1’	3/2/4 o !	II 2*
200	83	0.46	0.3	0.6	10’	1/1/1 o x	I 3*	0.34	0.3	0.6	3’	2/2/2 o !	II 3*
300	125	0.49	0.3	0.5	20’	3/2/3 o x	I 4	0.41	0.3	0.6	15’	4/4/5 o !	II 4
400	167	0.54	0.3	0.8	102’	3/4/2 o x	I 5	0.47	0.3	0.8	20’	5/8/5 o !	II 5



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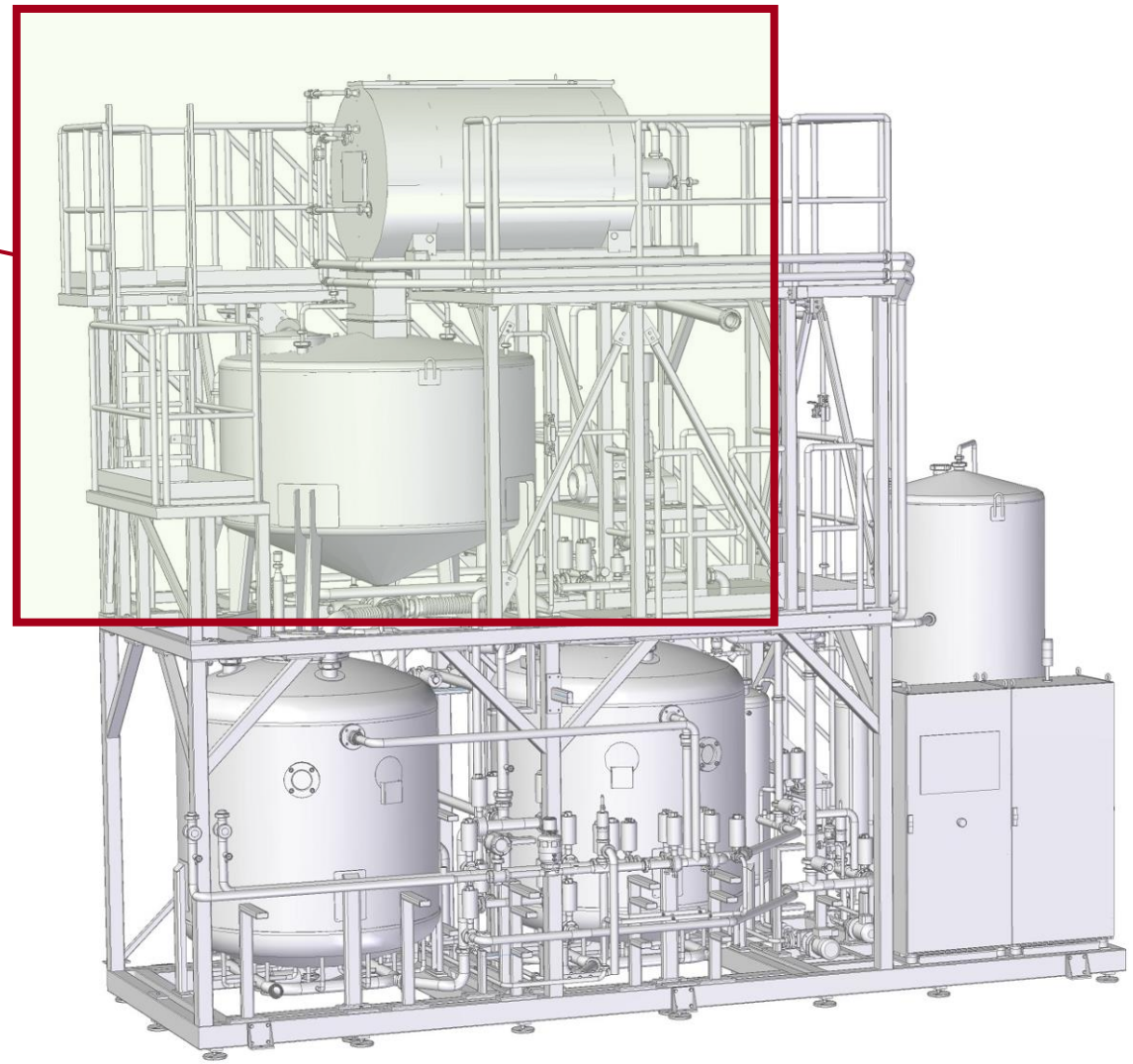
Resin Plant Design – Cloudy Products

Resin washing and transfer system



Continuous debittering plant for <u>cloudy</u> citrus juice

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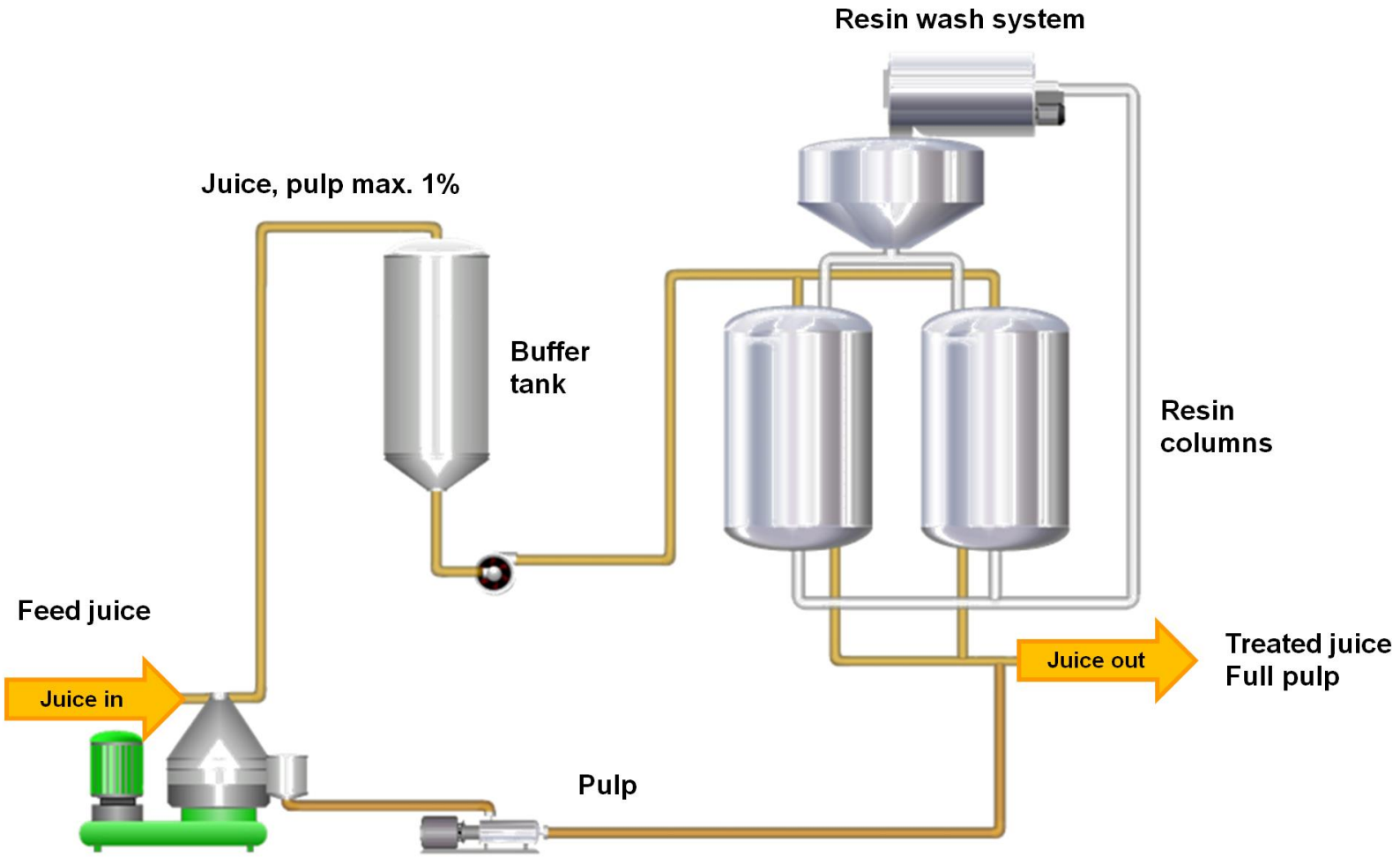
Process – Cloudy Products



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Debittering of Cloudy Products

Typical debittering results of various citrus juices and extracts:

Feed Processed with **Alimentech P495**	°Brix	Input (mg/L)		Output (mg/L)	
		Limonin	Naringin	Limonin	Naringin
Navel Orange Juice	12	6~20	-	<1	-
Navel Peel Extract	4	50	-	<1	-
Valencia Peel Extract	8	30	-	<1	-
Kinnow Juice	11	18	-	<1	-
Grape Fruit Juice	10	25	600	<5	<250
Grape Fruit Peel Extract	5	50	8000	<10	2000

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Acid Reduction

Reduction of fruit acid - increasing Bx/acid ratio

- Early season / less mature fruit
  → Increase B/A ratio from 8-9 to 12-14
- Produce low acid / high ratio juice with ratio's e.g. > 21 ("mild")
- USA FDA (21CFR 146.148) allows for high ratio (21-26) juice can be prepared using resins
- Generally not permitted in the EU for juices
- Ascorbic acid (vitamin C) level not materially affected
- Technology: anion exchange resin with partial bypass

Further Applications

... and still more possibilities

- Production of fruit sugar concentrates (IEX + Adsorber)
- Extraction of natural colourants, polyphenols, …
- …

but ... **Profitability needs to be carefully assessed !**

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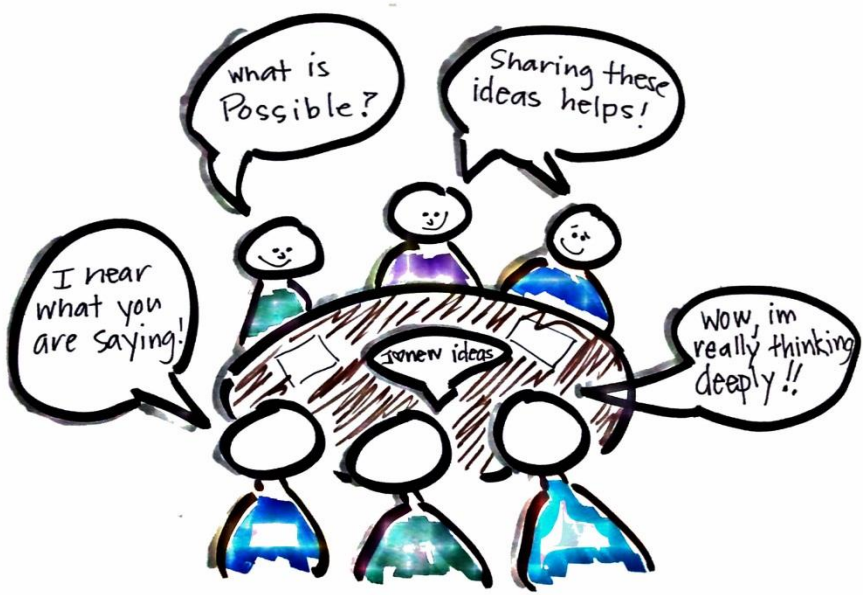
Thank you !



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Plant proteins as gelatin substitutes – an overview

Pflanzliche Proteine als Gelatinealternative – ein Überblick

www.erbsloeh.com

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Agenda

A user´s point of view

- why plant based?, legal aspects
- clarification and stabilisation
- protein products w/ approval (pea, wheat, potato)
- other proteins (w/o approval)
- overview, preliminary conclusion

why plant based?

- vegan diet
- religious reasons
- technological advantages

legal aspects

- **approved** (Council Directive 2001/112/EC of 20 December 2001)
  - pea, wheat, potato
- about to be approved: sunflower
- problem: missing approval for organic

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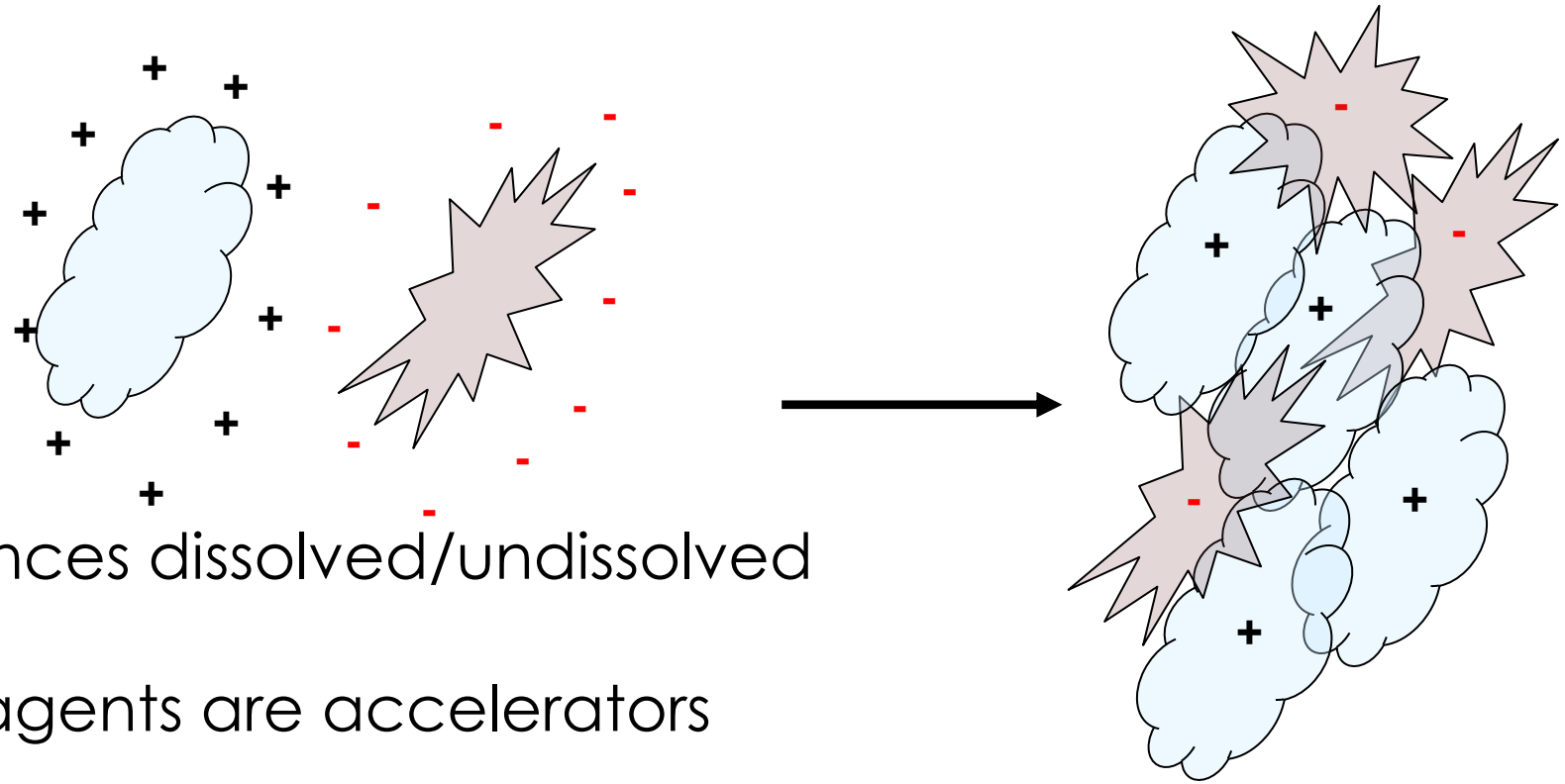
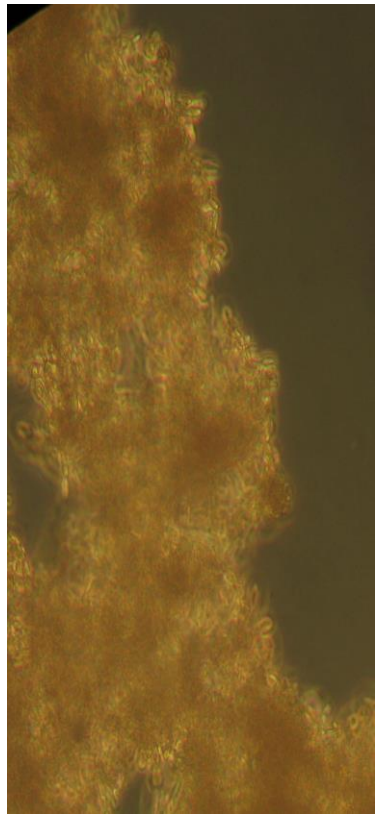
clarification and stabilisation





- substances dissolved/undissolved
- fining agents are accelerators
- stabilising effect

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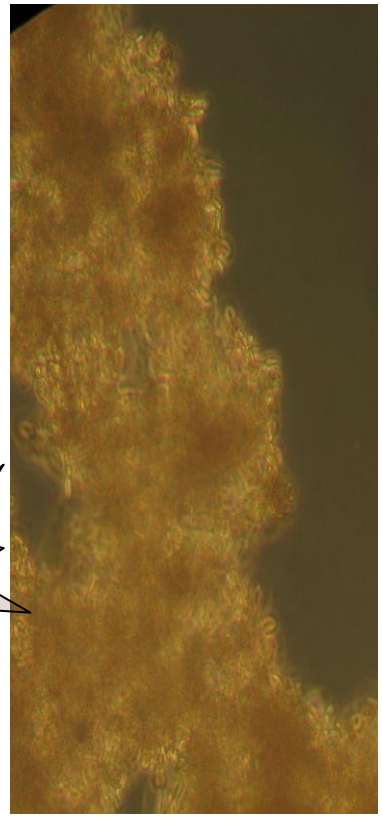
clarification and stabilisation

a. bentonite → mainly protein adsorption
b. gelatin → polyphenol adsorption
c. 5-fold silica sol (30%) → protein adsorption plus protection from overdosing

order vegan:

a. plant protein → NO danger of overdosing
b. 4-5-fold silica sol or 0,3-fold tannin
c. bentonite



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pea

- approved and established
- missing approval for organic(estim. end of 24)
- functional with silica sol
- better results w/ tannins
- protein content > 93%
- more convenient handling vs. gelatin
- disadvantage in price vs. gelatin

FloraClair (1% suspension)

pea

works great on berry wines

immediate sedimentation after 20 g/hl protein + 80 g/hl silica sol + 200 g/hl bentonite

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wheat gluten

- allergen !
- most samples contained starch !
- good & stable results esp. on red products
- adhesive flocculation in working solution
- higher amounts needed vs. pea
- protein content > 80%
- interesting price (slight advantage vs. gelatin)

wheat gluten (1% solution)

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wheat gluten

- works best with tannin

ciderbase: immediate sedimentation after tannin + bentonite

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potato

- byproduct of starch processing
- big disadvantage in price
- ½ samples contained starch
- varying solubility
- only 1 sample with good results
- tends to work better with tannin
- sensory impact (wine)

(1% suspension)

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sunflower

- byproduct from oil milling
- protein content 53%
- coarse particles
- interesting price
- works better with tannins

(1% suspension)

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sunflower

- minor influence on colour

(diluted red currant juice)

20 gr/hl sunflower + 100 gr/hl silica sol + 200 gr/hl bentonite

coarse filtered only

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flocculation

(in pear juice)

FloraClair

potato

sunflower

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sedimentation

technological relevance:

- product loss, re-work of sediments

sunflower canola untreated

apple juice + 80 g/hl protein overdosage + 80 g/hl silica sol + 200 g/hl bentonite

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sedimentation

technological relevance:

- turbidity and filterability

gelatin pea potato gluten

apple juice + 80 g/hl protein overdosage + 80 g/hl silica sol + 200 g/hl bentonite

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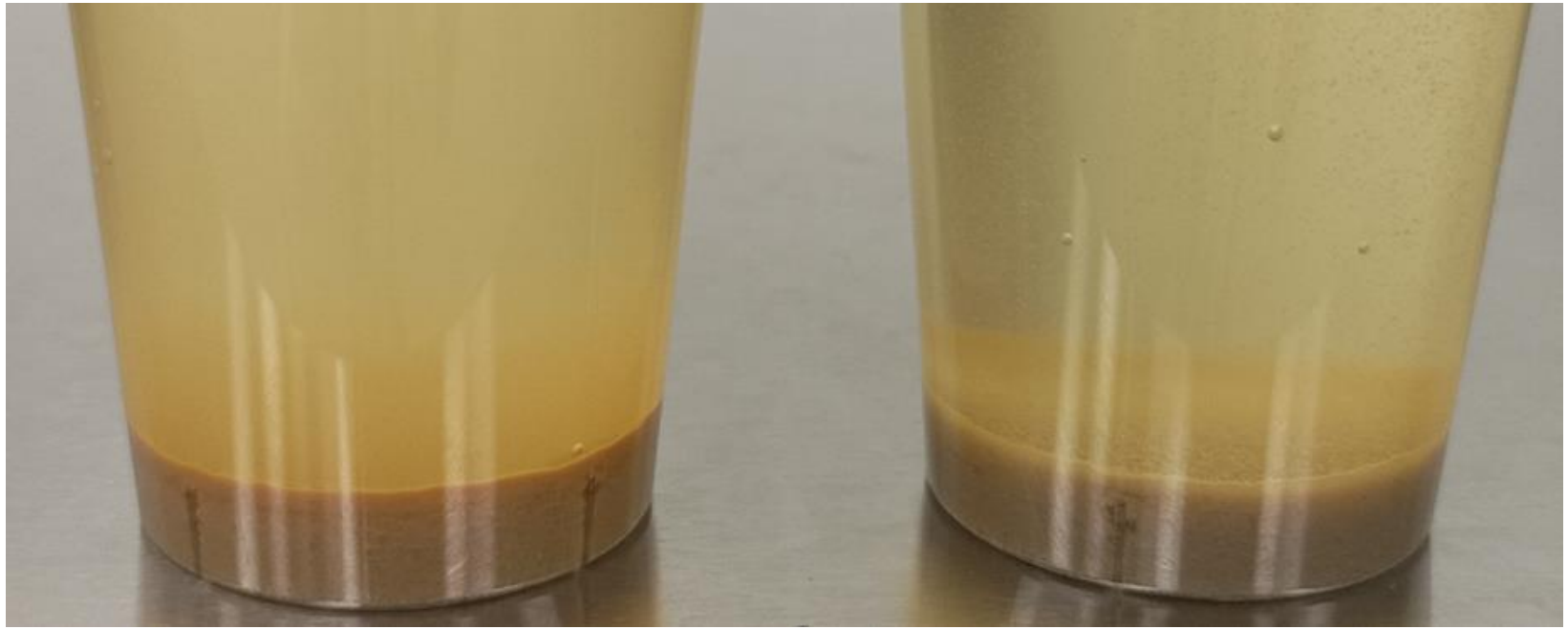
sedimentation

- Ciderbase: improved sedimentation with Tannivin Galleol (r.)



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effect on colour

80 gr/hl overdosed plant proteins do NOT result in a major loss of colour

coarse filtered only

gelatin | FloraClair | potato | gluten | sunflower

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other proteins (w/o approval)

- yeast → prone to sensory transformation (storage)
- canola → outstanding on apple/pear, large sediment volume, decolorisation
- rice → sample containing starch
- favabean → unstable results but best on vinegar
- mungbean → similar to fava
- soy → bad filterability but stable results
- carrageen → handling similar to gelatin, weakest overall results

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overview, preliminary conclusion

Which protein for which application?

		technological advantage vs. gelatin (sediment, filterability, stability)
• pea, sunflower	apple juice	
• pea, potato	pear juice	
• potato, (favabean)	apple vinegar	✓
• pea, potato	cherry wine	✓
• pea, gluten	cider base	✓
• pea, (sunflower)	blueberry wine	✓
• pea, (sunflower)	fruit wine base	✓
• pea, (sunflower)	mead	✓
• pea, potato	black currant juice	
• pea, (canola)	red currant nectar	✓

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overview, preliminary conclusion

Valid for all examined plant proteins:

- „over fining“ practically impossible
- pre-swelling recommended
- prepared solutions may be stored for several days
- lower protein contents do not necessarily result in higher dosages
- less colour reduction vs. gelatin (red products)
- tendencially higher amounts needed vs. gelatin
- functionality at low temperatures (< 12°C) similar to gelatin
- fining works better with tannins than silica sol

Thank you for your attention !

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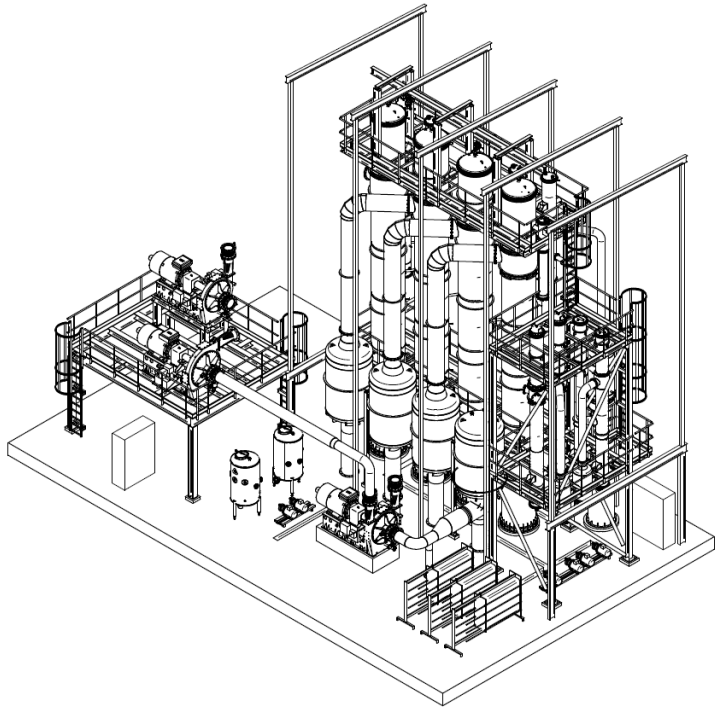
MVR Evaporators –
the key to energy efficiency in juice concentrate manufacturing

BUCHER unipektin

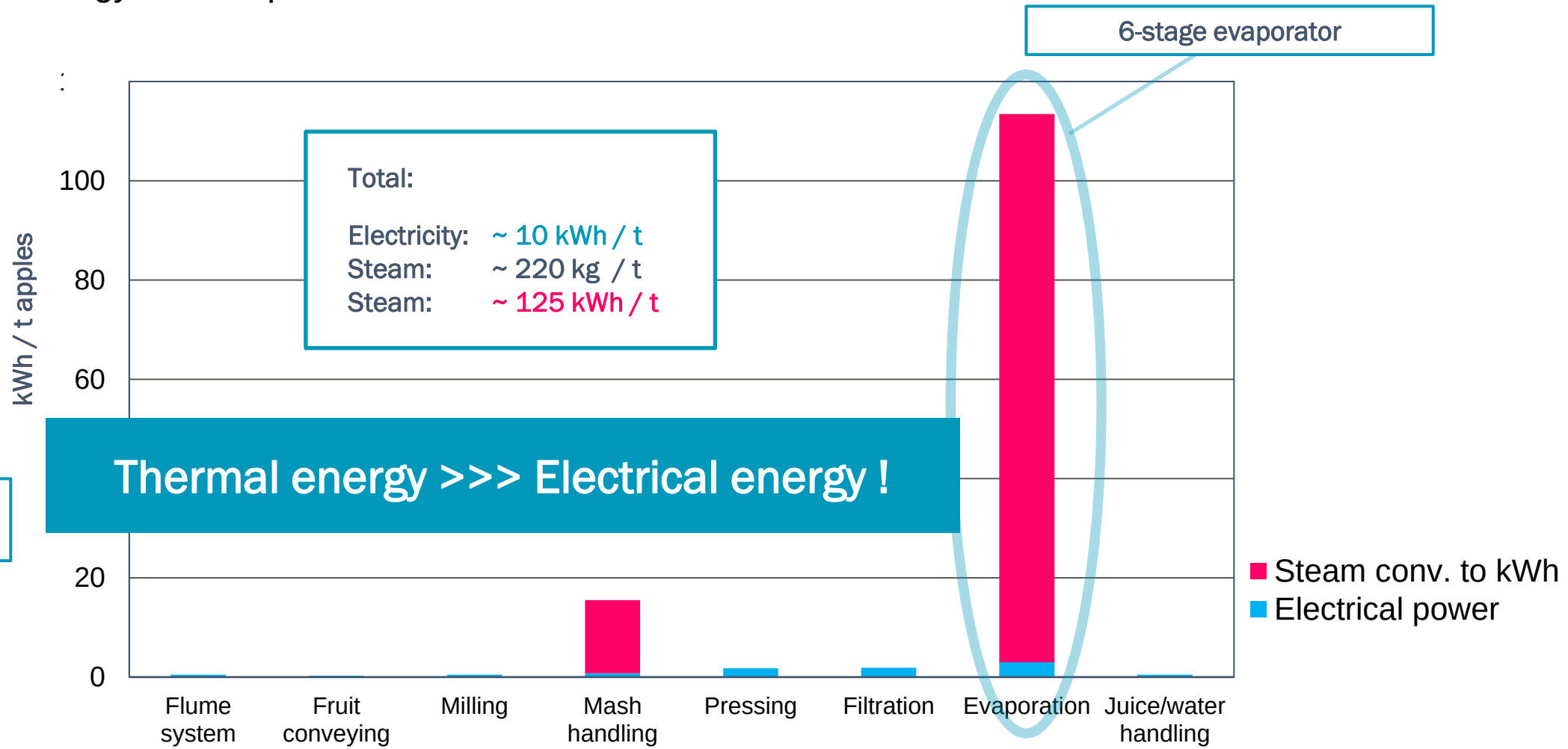
Dr. Michael Welte
Head of Process Engineering

Public



Energy consumption in juice concentrate processing

Typical specific energy consumption for AJC line with 30 t/h



Consumption figures per t of processed fruit

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Energy consumption in juice concentrate processing

What can be optimised ?

With conventional 6-stage evaporator

Energy to process 1 t apples into apple juice concentrate (AJC)

- **Electrical energy:** 9-10 kWh/t (8% of total)
- **Thermal energy (steam):** 125 kWh/t (92% of total)
  (± 220 kg/h steam)
- The specific consumption of thermal energy is approx. **12x higher** than the consumed electrical energy !

→ The key to reduce the overall energy consumption is to **reduce the required thermal energy**.

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Energy consumption evaporators

Some basics of thermodynamics

- 1 kg steam is required to evaporate 1 kg water
  (+ pre-heating, + dissipation losses …)
- Produced vapours contain the evaporation energy
  → they can be reused as energy source
- Multi effect evaporators use this „energy recycling“ effect
  up to 7x
  → effective steam consumption as low as 0.2 kg/kg WE
  → established standard technology in FJC production since >50 years

2256 kJ/kg
@ 1000 mbar

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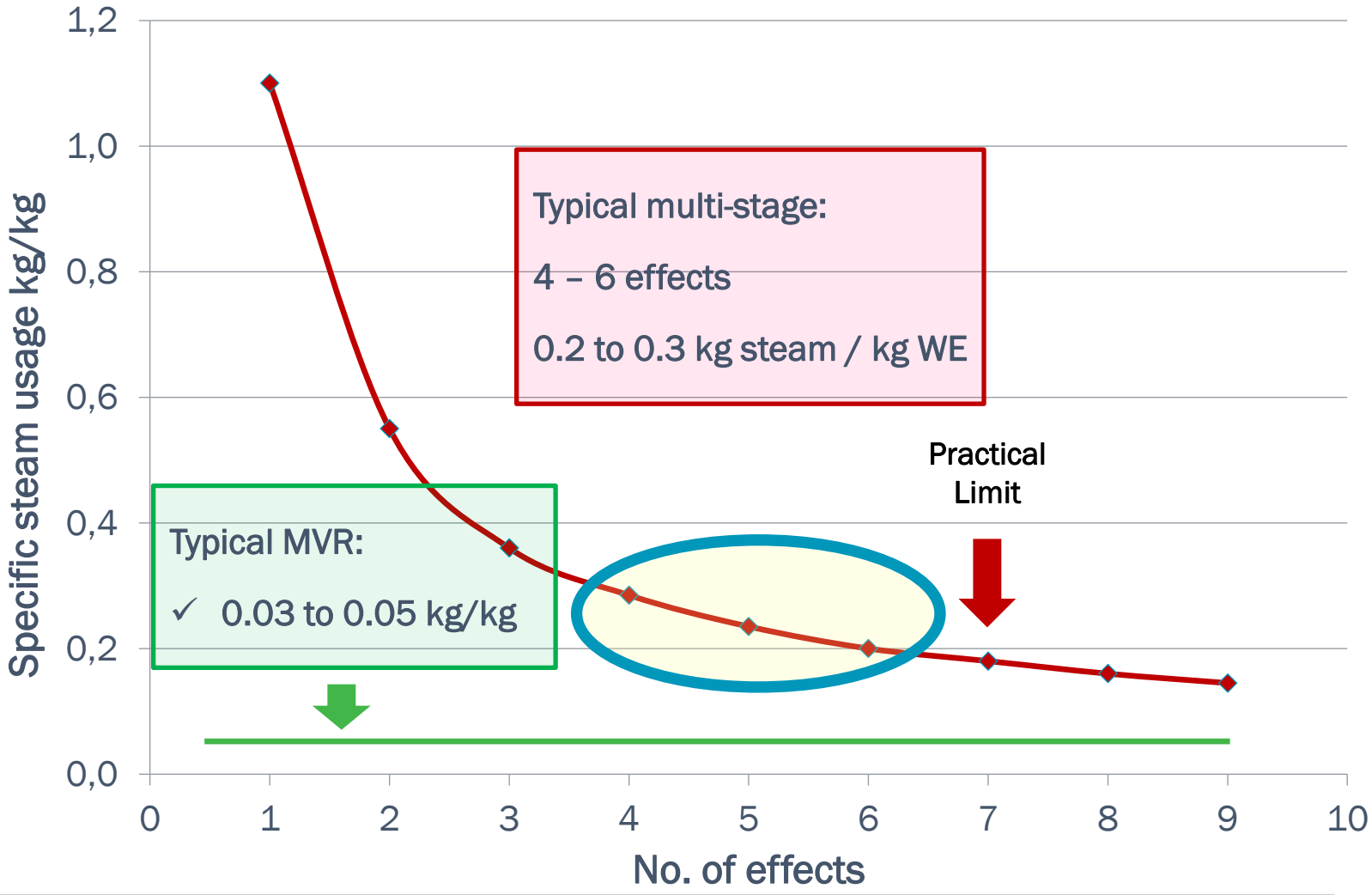
Energy consumption evaporators

Multi stage vs. MVR



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MVR evaporators

Principle of operation

MVR: Mechanical Vapour Recompression

- Vapours are mechanically compressed
  → increase in temperature
  → increase in specific energy
- Compressed vapours can be reused to heat the source they come from
  → 100% of the evaporation energy is recycled

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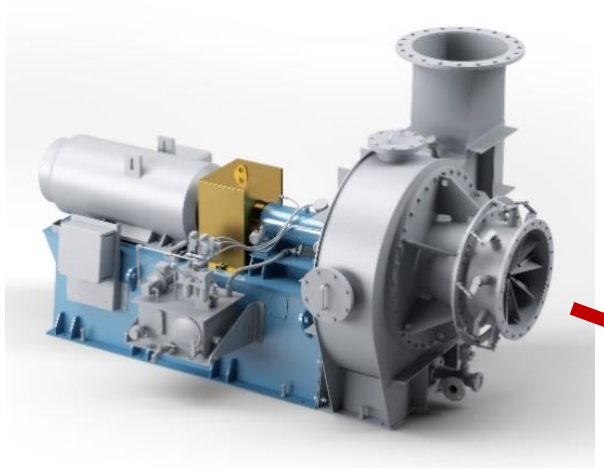
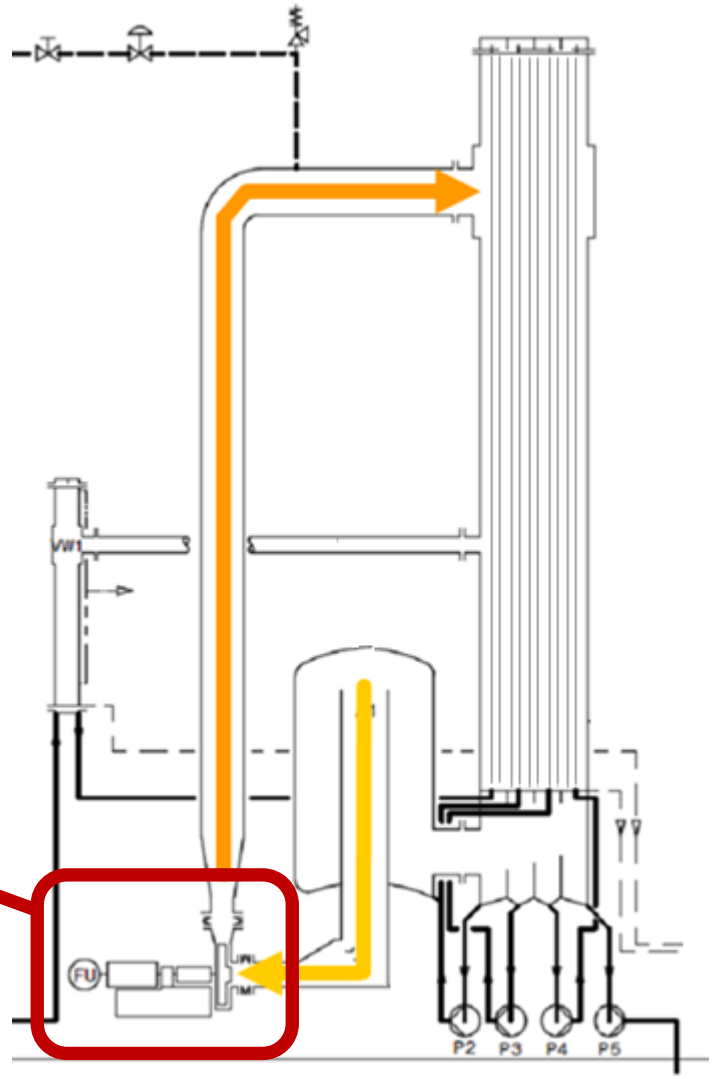
MVR evaporators

Principle of operation

Radial fan compressor





Challenges:

- How to combine pre- and final concentration ?
- How to extract the aromas ?
- How to achieve 70 °Bx ?

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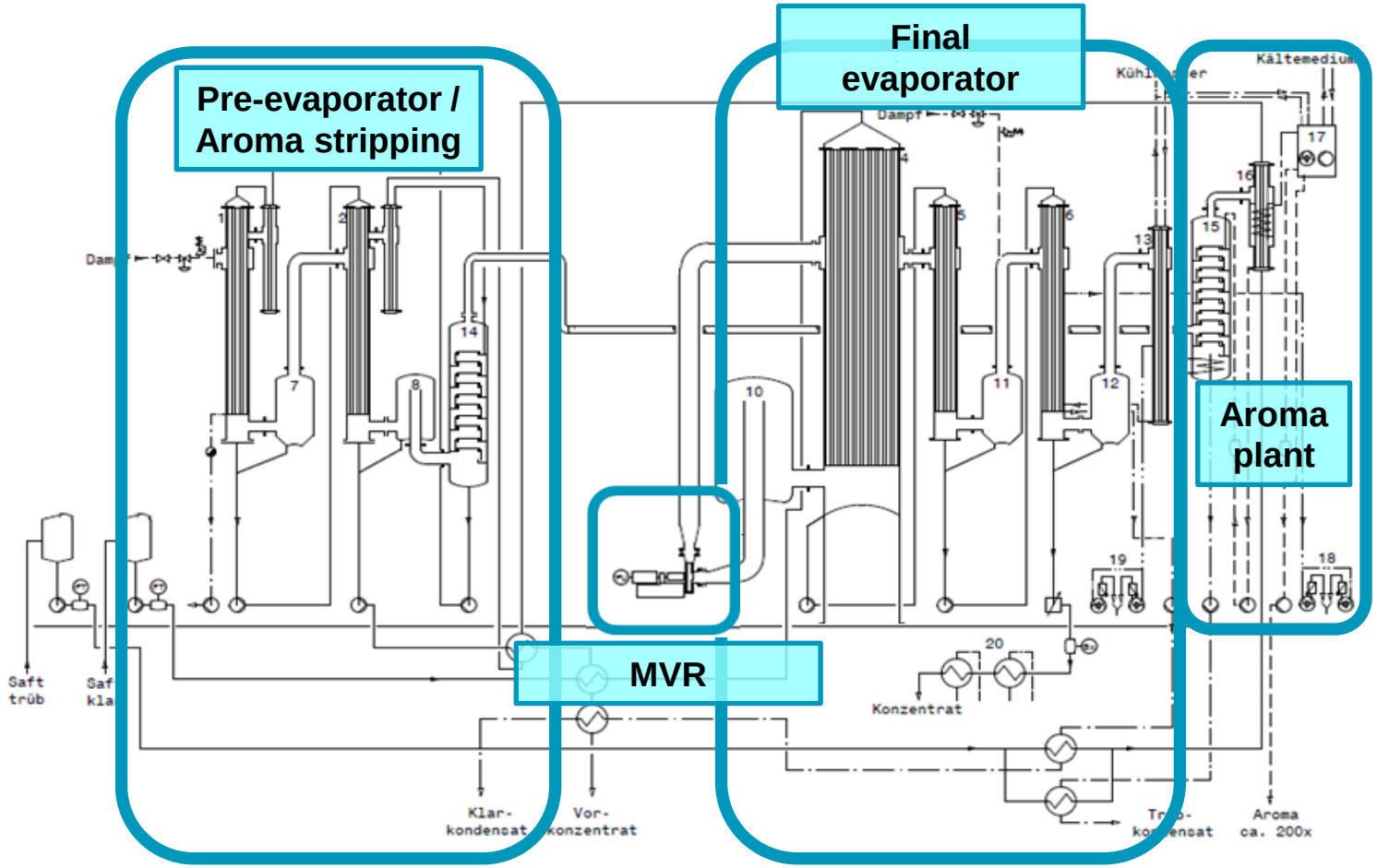
The 1st Generation Bucher Unipektin Solution

MVR heated single-stage evaporator with aroma strip column

Combi fruit fuice
MVR evaporator

- 2-stage pre-evaporator with aroma strip column
- MVR heated final evaporator with 2-stage finisher
- Aroma concentration plant



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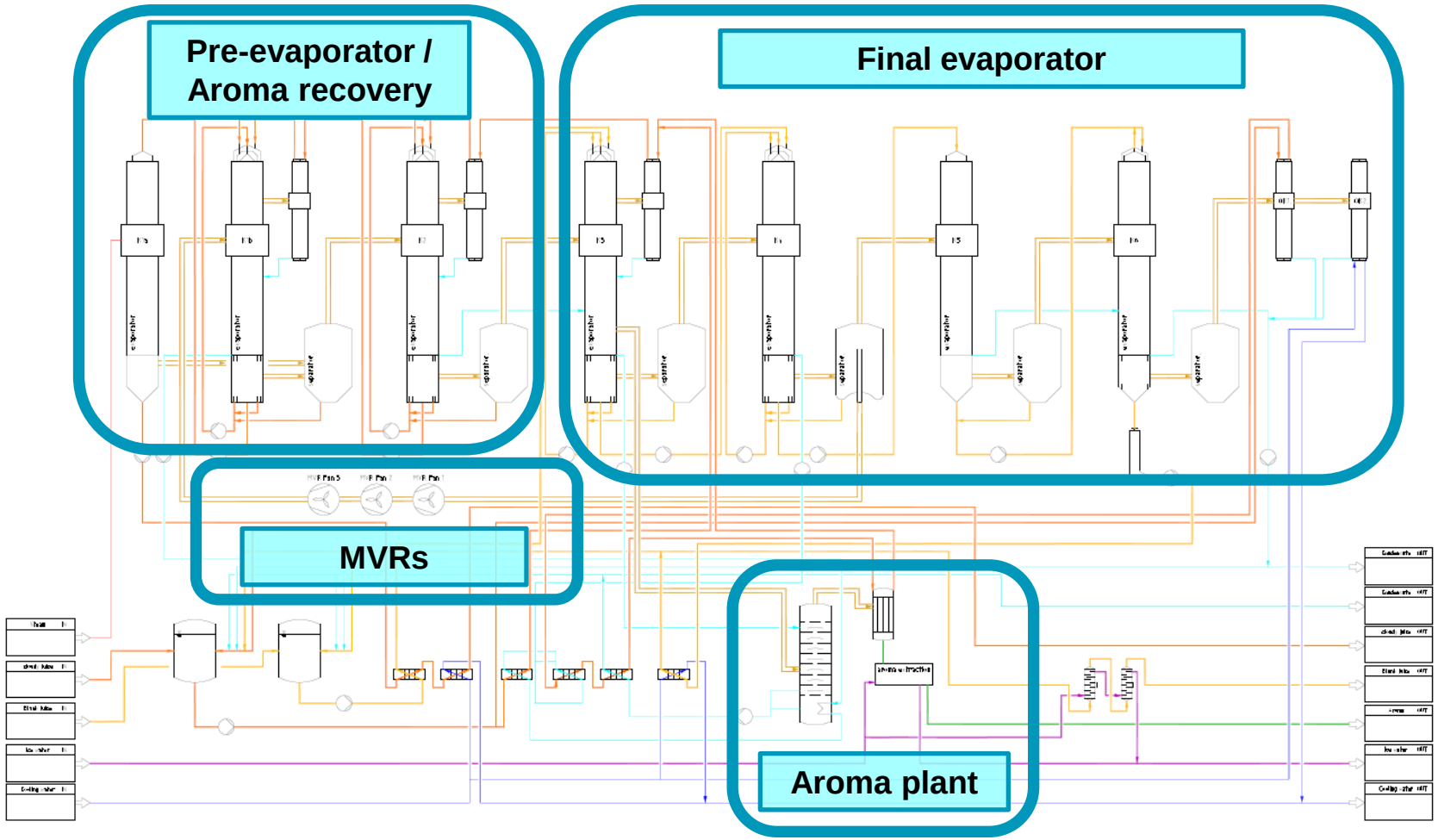
The 2nd Generation Bucher Unipektin Solution

Multi-MVR heated multi-stage evaporators

Combi fruit juice multi-stage MVR evaporator

- 4-6 stage multi-stage evaporator
- Heated with 3-7 MVRs in series
- 2-3 small expansion stages / finishers for final concentration
- Conventional aroma concentration plant
- Same concept for new plants and **upgrades of existing multi-stage evaporators**
- **Bucher Unipektin up to date the only supplier to provide multi-MVR solutions !**



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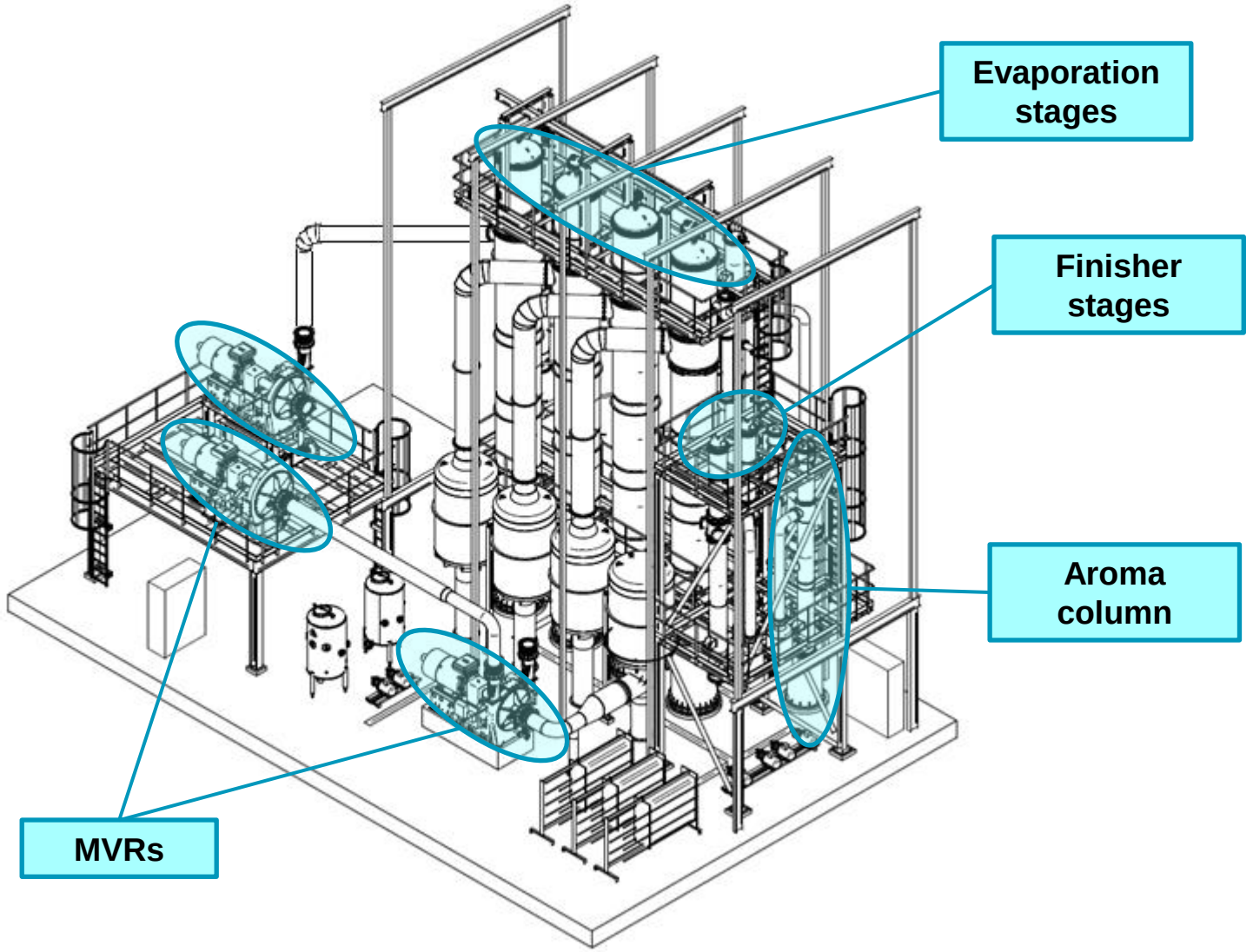
The 2nd Generation Bucher Unipektin Solution

Multi-MVR heated multi-stage evaporator

Typical combi fruit juice multi-stage MVR evaporator

- With 3x MVRs
- With 4x evaporation stages
- With 2x finisher stages



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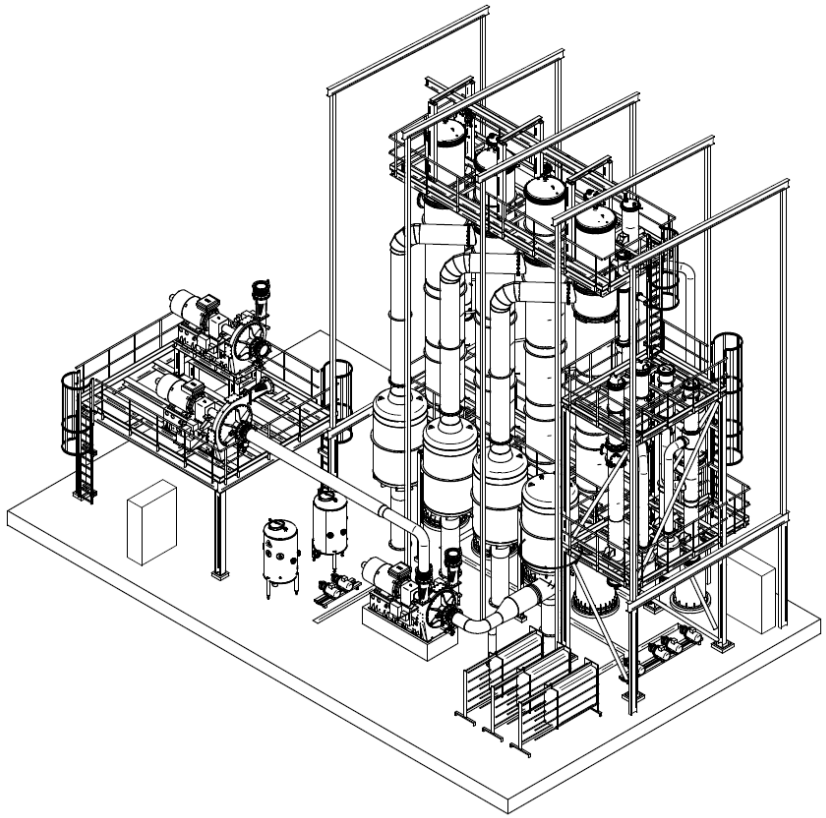
Benefits: The 2nd Generation

- Reduced energy consumption (conventional aroma plant !)
- Higher level of pre-concentration
- Same concept for new MVR evaporators and update of existing multi stage plants
- Lower production and transportation costs
- Cost efficient MVR-upgrade for existing plants
- Cost efficient spare part concept for multi-fan evaporator
- Later capacity expansion often possible
  (by adding 1 x body & 1 x MVR)



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MVR vs. conventional multi-stage evaporators

Energy consumption and operating cost

Operating data	6-stage conventional		4-stage MVR		
Water evaporation	**30.0**	t/h	**30.0**	t/h	
Steam usage	6.21	t/h	1.11	t/h	
Steam usage, specific	0.207	kg/kg	0.037	kg/kg	- 82%
Electrical power usage incl. cooling tower circuit	130	kW	635	kW	+ 490%
Total energy usage (electrical + thermal)	4'150	kW	1'350	kW	**- 67% !**
Cooling tower condensation capacity	1'600	kW	100	kW	**- 94% !**

Operating cost (EUR)	6-stage conventional		4-stage MVR		
Steam cost, specific	**65**	EUR/t	**65**	EUR/t	
Electricity cost, specific	**0.25**	EUR/kWh	**0.25**	EUR/kWh	
R (steam/electricity)	260		260		
Operating time	**3'000**	h/year	**3'000**	h/year	
Steam cost, total	1'211'000	EUR/year	216'000	EUR/year	
Electricity cost, total	97'500	EUR/year	476'000	EUR/year	
Sum cost steam + electricity	1'308'500	EUR/year	692'000	EUR/year	
OPEX Savings			**-616'500**	**EUR/year**	**- 47% !**

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Bucher Unipektin MVR evaporators – green and smart !

An MVR evaporator can save >80% fossil fuels and CO_2 emissions when electricity comes from renewable sources

OPEX reduction is significant with attractive payback for additional investment:
ROI typically 2-3 years
(with actual energy prices in Europe)

Bucher Unipektin concept equally applicable for new plants or for upgrading of existing multi-stage evaporators

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Thank you … and see you soon !

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